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MANUFACTURER'S CATALOG DATA OF AUTOMATION AND SURVEILLANCE SYSTEMS FOR UTILITY PLANTS AT FORT LEONARD WOOD, MISSOURI, VOLUME 2

Burns and McDonnell

Prepared for:

Army Engineer District

30 April 1975

Manufacturer's Catalog Data

of

Automation and Surveillance Systems for Utility Plants

at

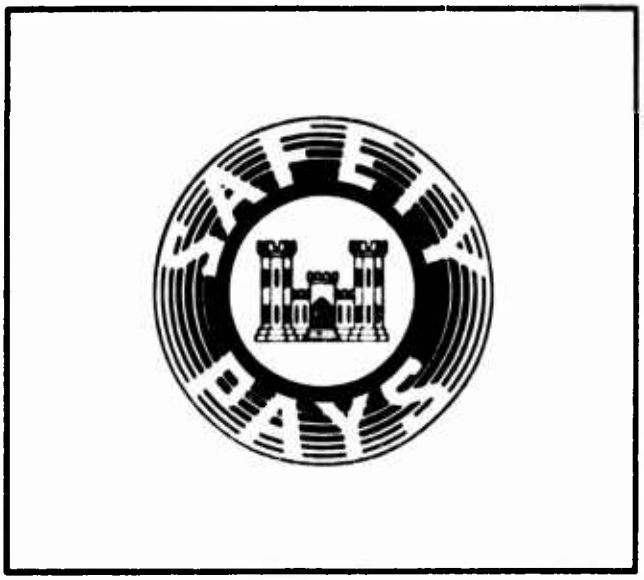
Fort Leonard Wood, Missouri

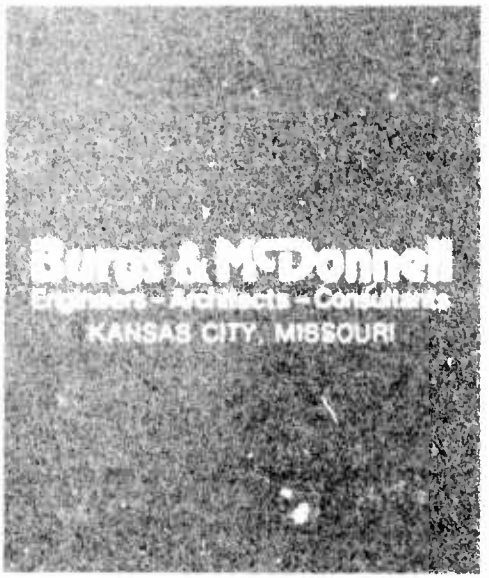
for the

U.S. Army District, Omaha

Volume 2 of 2

1975





Burns & McDonnell / Engineers - Architects - Consultants

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4600 EAST 63rd STREET

April 30, 1975

Mr. Paul Dappen, Project Manager
Department of the Army
Omaha District, Corps of Engineers
6014 U.S. Post Office and Court House
Omaha, NB 68102

Re: Study of Automation & Surveillance Systems
Contract DACA 45-74-C-D108
Our Project 74-051-4

Gentlemen:

In accordance with your instructions, we have made a study and report for automation and surveillance systems for utility plants at Fort Leonard Wood, Missouri.

This report is presented in two volumes. The breakdown for each volume is as follows:

Volume 1 of 2 - Part I Central Supervisory Control System
Part II Water Supply, Treatment and Distribution
Part III Sewage Lift Stations
Part IV Heating and Air Conditioning Equipment
Part V Cost Estimates
Part VI Technical Support Data

Volume 2 of 2 - Part VII Manufacturer's Catalog Data

We wish to acknowledge the generous service from Post personnel who furnished us information and assisted us in obtaining field data for this report.

2671 S. W. 27th AVENUE, MIAMI, FLORIDA 33133
TWO PENNSYLVANIA PLAZA, NEW YORK, NEW YORK 10001
7000 N. E. AIRPORT WAY, PORTLAND, OREGON 97218

We will be pleased to discuss this report with you and make available any information we may have.

Sincerely yours,

Arthur W. Homer

Arthur W. Homer, P.E.

AWH/mg

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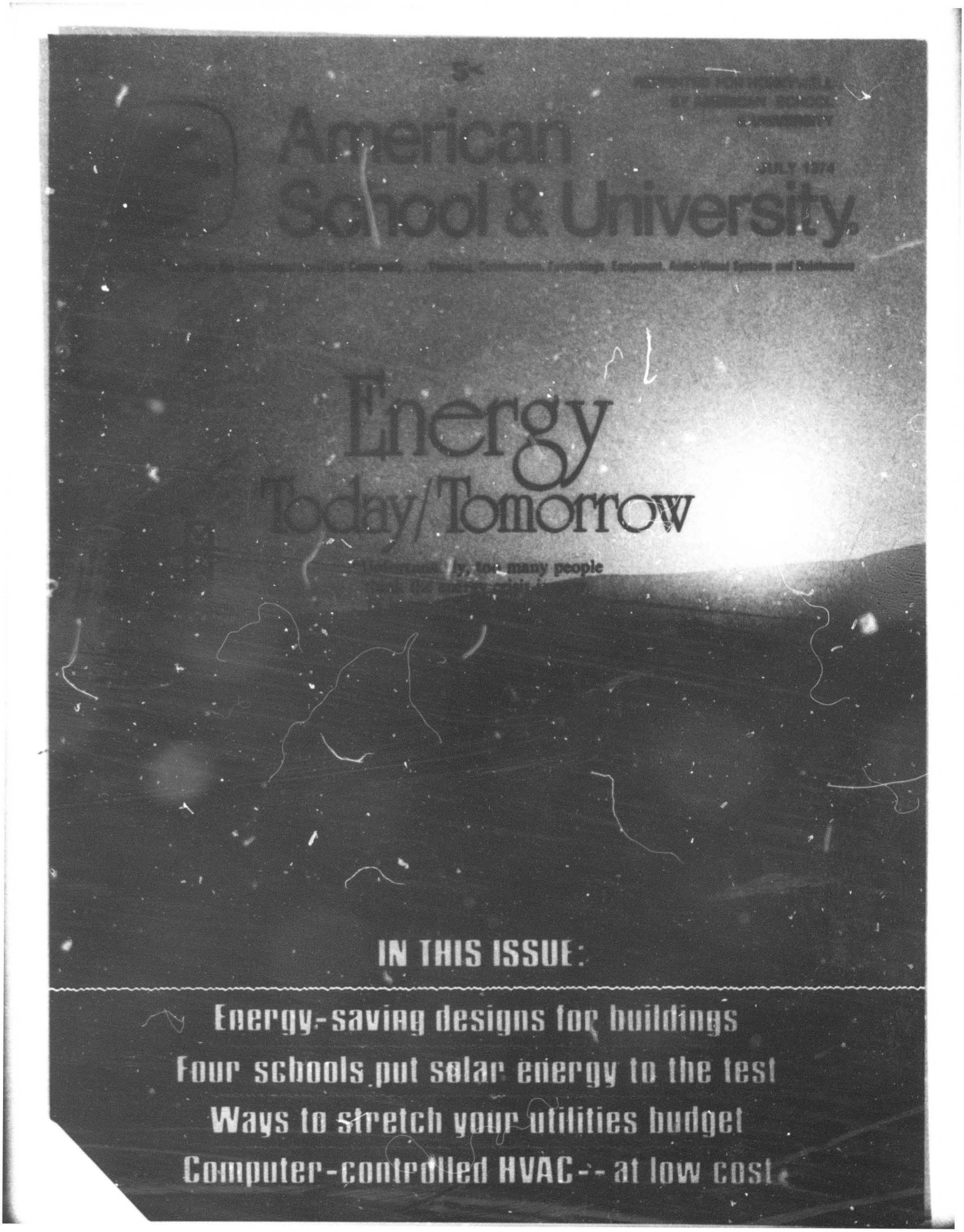
PART VII - MANUFACTURER'S CATALOG DATA

Honeywell, Incorporated

Powers Regulator Company

Johnson Service Company

Barber Coleman Company


American School & University
JULY 1974
Energy Today/Tomorrow
IN THIS ISSUE:
Energy-saving designs for buildings
Four schools put solar energy to the test
Ways to stretch your utilities budget
Computer-controlled HVAC -- at low cost

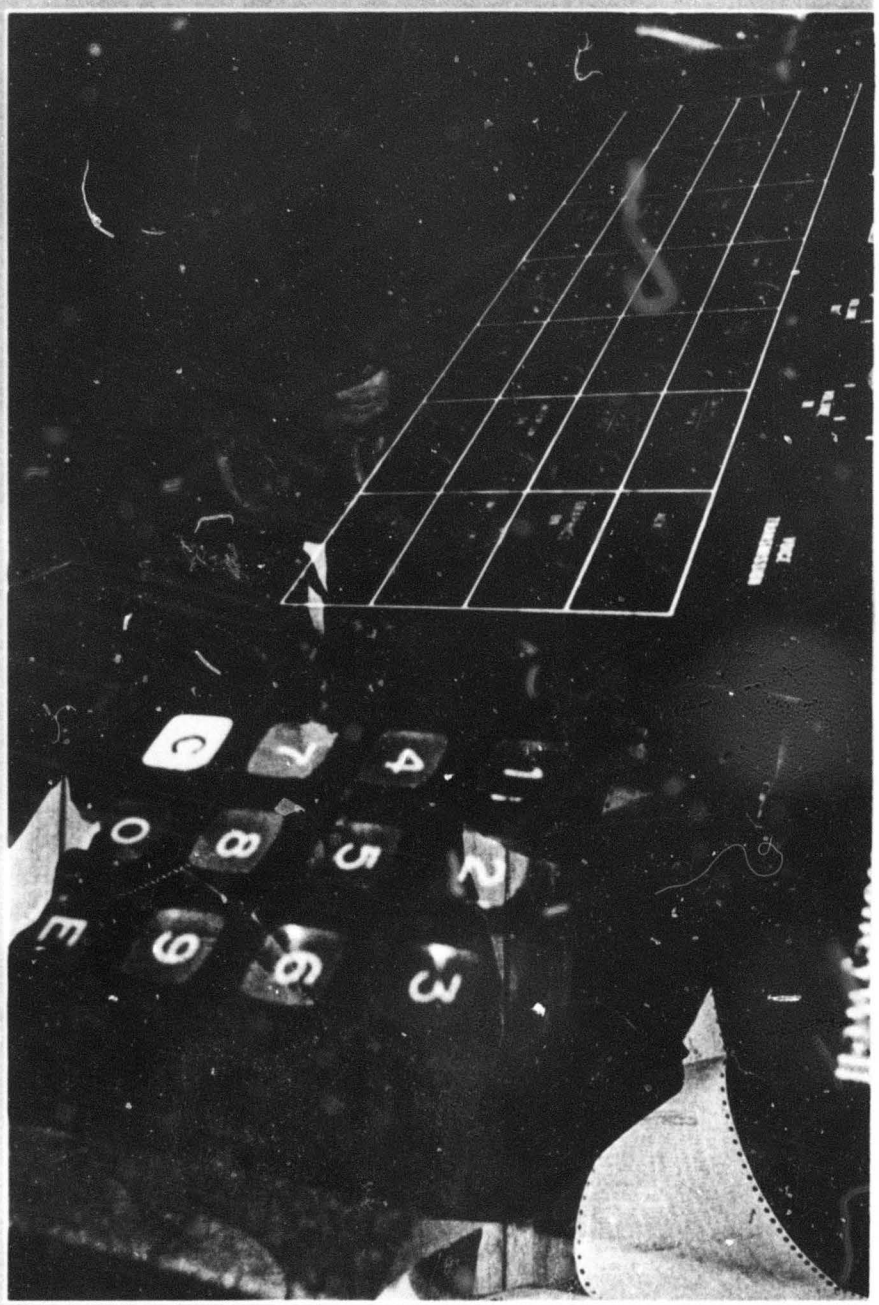
Computer-controlled HVAC —at low cost

By tying into a computerized building-automation network, Schaumburg High School, Schaumburg, Ill., has slashed its energy consumption by one-third. Actual fuel and power savings are running at a rate almost double the original projection—and the savings will amount to $28,000 per year.

Although Schaumburg is reaping all the advantages of computer-controlled HVAC, it did not purchase, lease or install a computer. Instead, the school has tied into a unique computer-center 20 miles away. The center specializes in automatic, remote control of mechanical systems in buildings.

Obtaining the benefits of the automation network costs Schaumburg $14,000 per year (including charges for the leased telephone lines). In addition, there was a one-time connection charge of $12,000 to cover the electronic sensors and equipment tie-in.

Comparing costs against savings shows the system will offset its connection charge and rental the first year; after that it will return a 100 percent profit. In constant dollars, the system will offset its rental twice-over every year. Actual dollar savings will show an even greater return.



Remotely-located computer controls the mechanical system for Schaumburg High School as well as other buildings in the community. The cost is shared by all.

In addition to controlling HVAC equipment, the computer prepares equipment-performance reports for superintendent Dr. Richard Kolze (seated) and business manager James Slater (standing).

Schaumburg is in Illinois Township High School District 211, which covers Palatine, Hoffman Estates and Schaumburg, three booming suburbs some 30 miles west of downtown Chicago. The area is one of the country's fastest-growing, with office buildings, industrial parks, shopping centers—including Woodfield, reported to be the world's largest—and homes going up all over.

Also going up is the population, which of course affects the schools. The District, headed by Superintendent Dr. Richard Kolze, has five senior highs averaging around 2200 students each. On the boards is one more slated for completion in 1976, and the Board of Education has acquired two additional sites to accommodate student growth beyond 1976.

Situation Before The Computer

Schaumburg is a 4 year old school with 127 classrooms, a gymnasium, a cafetorium and two large group instruction rooms for team teaching. The school is air-conditioned by 20 gas-fired rooftop units housed in two penthouses; heating/ventilating units which handle the gym, locker rooms and kitchens; and several electric resistance units which furnish auxiliary heating for hard-to-heat stairways.

For 3 years, the rooftop units worked double shifts. Started at 5 a.m. each day, they were left running all day long—and most of the night too.

The long operating day had a certain logic. It took the 2-man maintenance crew 2 hours every morning to get all 20 rooftop units running. Starting at 5 a.m. meant that the crew could move onto other tasks by the time the school opened. The evening staff began shutting down the units at 10:00 p.m.

The result was that mechanical equipment operated 19 hours a day to serve a school operating only 9 hours. In terms of functional use, more than half the equipment's operating day was wasted.

Initially Schaumburg school relied on time clocks to start and stop the rooftop units—"A poor system," sniffs district maintenance engineer Walter Jarog. The clocks kicked-on 10 rooftop units at a time, meaning a sizable current inrush which often damaged electrical equipment. It also meant a sizable demand penalty.

In a power outage, the time clocks were knocked out along with everything else. When power was restored, operating schedules were completely awry. Worse, the clocks couldn't bring the rooftop units back on again, so each had to be restarted individually.

After some irritating experiences, the time clocks were abandoned and the units were started and stopped manually.

Meanwhile, the crew was falling further and further behind on routine maintenance, not only of the units but of other mechanical components as well. As a result, the school's maintenance staff was continually plagued with emergency breakdowns requiring emergency repairs—at emergency prices.

Yet despite soaring maintenance costs, Jarog wasn't getting good performance. "On the average we had 3 rooftop units down all the time. Not the same 3, of course, but an average of 3. And we've had as many as 10 out at once," he sighs.

The New System—How It Works

Faced with the problem of spiraling maintenance costs and sinking mechanical performance, the Board of Education let competitive bids for a computer-controlled building-automation network which offers cost-shared building operation on a lease basis. Honeywell's Commercial Division, Minneapolis, was the successful bidder.

Sleek-lined Schaumburg High School has 20 air conditioning units enclosed in two penthouses on the roof.

The school is now linked electronically—using leased telephone lines—to a compact Delta console some 20 miles away. There a trained operator checks, correlates and controls all mechanical equipment in the school. Simply by touching push-buttons he can start and stop each rooftop unit independently, as well as run 4 large ventilating fans, two gas-fired hot-water boilers, other system components, plus the school's outside lighting.

In all, the console keeps a beady eye on nearly 100 checkpoints scattered throughout the three-story school. If, for example, a classroom temperature goes too high, the console operator 20 miles away would know about it before anyone right in the room itself.

In case of trouble, an alphanumeric screen in front of the operator spells out what went wrong where; at the same time twin "electronic secretaries"—actually alarm printers—rap out a permanent record of the problem.

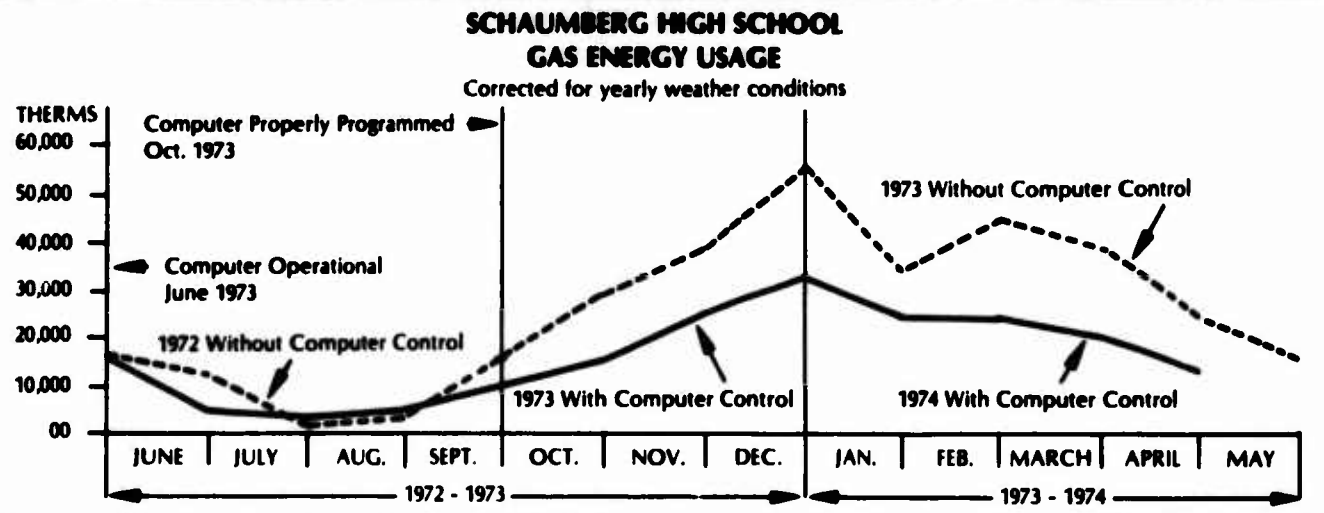
The printers also make regular logs of equipment performance, giving the operator immediate indication of any off-normal condition. This means he can spot troublesome trends early, pinpointing problems before they become breakdowns.

Actually this was the Board's original rationale for tying into the system—to get advance warning of any troubles to prevent recurring breakdowns.

"We were playing catch-up maintenance—and losing," says Jarog. "Our men weren't skilled in repairing the sophisticated mechanical equipment we had. As a result, the only time a machine was thoroughly checked over was when it came to a screeching halt.

"But this wasn't the crew's fault. We simply couldn't afford the time to make regular checkouts all day long. If a rooftop unit went down at, say, 9 in the morning, the only way we'd know about it was if someone complained a classroom was too hot or too cold."

At first, the automation network



ran the school on the old schedule. But then district business manager Jame Slater questioned why the equipment had to be running 100 hours a week when the school wasn't.

Working with Honeywell engineers and school principal Carl Weimer, Slater and Jarog came up with an operating schedule reflecting actual school use. Those rooftop units now start at 7 a.m. instead of 5 a.m., and the computer staggers the start-ups to prevent inrush damage and expense.

Also, the units shut down a lot earlier. Those serving the kitchen and cafeteria go off at 2:30 in the afternoon; those for the classrooms go off at 3:30; and those for the gym keep running until 6 p.m.

As rooftop units are shut down, the computer closes outside-air dampers letting the building "coast" on its stored heat. In severe weather the computer cycles the heating on and off to maintain a 68 degree interior temperature.

Schedule changes are handled by telephone calls to the computer operator. By touching a pushbutton, the console operator can ventilate the gym for a night game, for example, or make the cafeteria comfortable for a play.

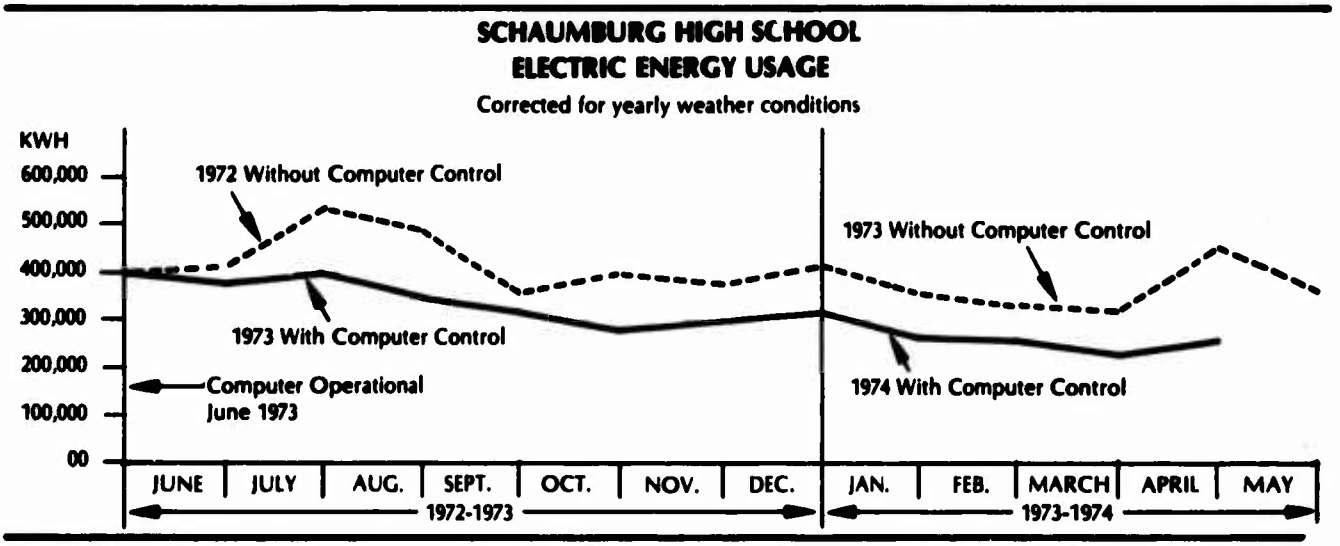
Another benefit is extended equipment life. "Because we're running the systems only 8 hours a day instead of 19, we figure the machinery should last three times as long," says Jarog.

Data from the automatic network is a valuable analytical tool as well. The District staff can, for example, spot sagging efficiencies that would otherwise go unnoticed. By comparing the increased fuel and power requirements against the cost of labor and materials, they can pinpoint the optimum time for overhaul or replacement.

With that kind of payout and performance from Schaumburg High, the Board of Education accepted the Superintendent's recommendation to expand the automated monitoring system to two additional existing schools during the current school year. Cost benefit studies are also underway to determine whether the system should be expanded to the remaining two schools and the Administration Center.

But welcome as the dollar savings are, the most important benefit for the District is assurance that the building systems are always operating the way they should.

Instead of limping along from day to day, the mechanical equipment is always in top-notch condition. And if anything goes wrong, the school's maintenance staff knows about it immediately.



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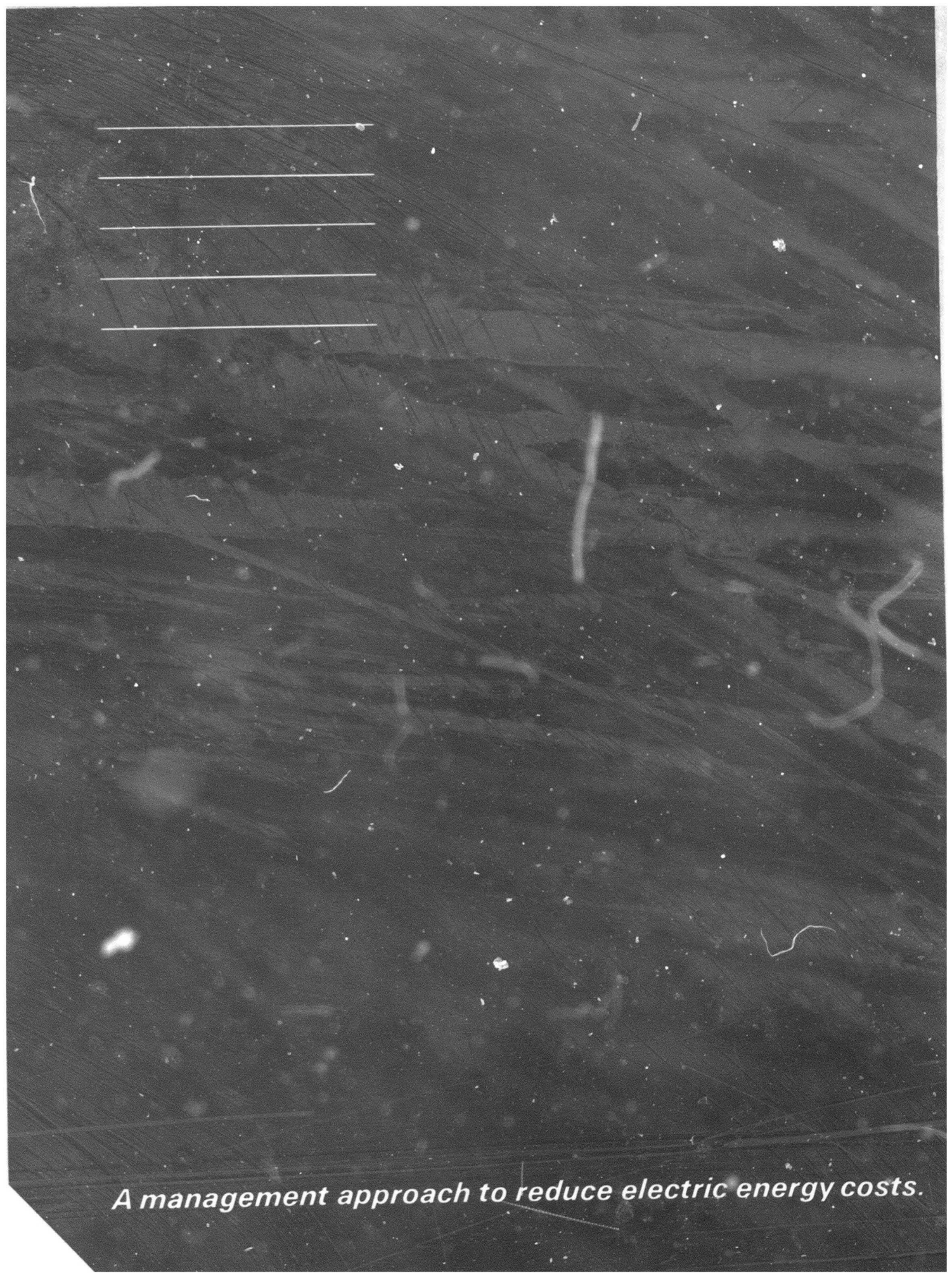

A management approach to reduce electric energy costs.

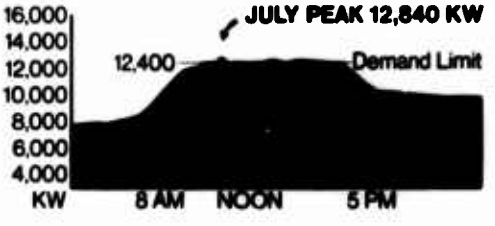
Electric Power Bills Too High?

Natural gas, oil, nuclear power, water—they are all used to produce electricity. And they are all related to the energy crunch we face today As costs to generate electricity continue to spiral, they are passed on to the consumer in the form of increased per-kilowatt charges and electric demand charges.

The first element of your electrical power bill is usage. The cost per kilowatt hour is directly related to the cost of fuel to produce electric power.

The second element is electric demand. This is the surcharge placed on each kilowatt based on your electric demand peak and is used by the power company to pay for the generating and transmission equipment used during peak hours. When current power consumption exceeds your previous peak, even for a few minutes, a new demand charge is added to your electric bill for the month, even though actual power consumption never comes close to that peak again. In many cases, the new demand charge prevails for another eleven months.

For example, the hourly electrical power consumption for a research center in the East on July 12, 1972 is shown at the right. During one 15-minute period, electrical power peaked at 12,840 KW. This was only 440 KW over their existing demand level, but a new demand charge was created and billed to the company over the next 12 months at an added cost of $7,260.



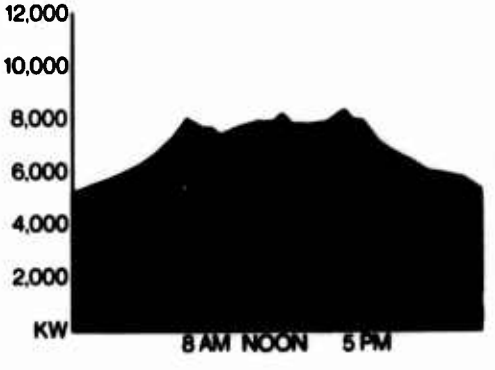
Honeywell's Energy Management System Controls Both Electrical Consumption...a

Honeywell's Delta 2000 energy management system lets you conserve electrical energy – kilowatt hours – through load scheduling . . .

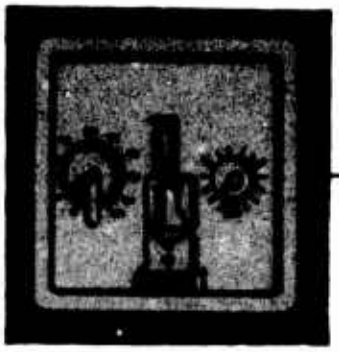
- Automatically start mechanical equipment as late as possible in the morning
- Automatically shutdown equipment as early as possible in the afternoon
- Simple override of automatic stop-time operation for off-hours occupancy with a secondary shutdown program for any overlooked equipment
- Control lighting

Delta 2000's remote start/stop feature reduces electrical energy consumption through delayed morning startup and accelerated afternoon shutdown. Energy waste while operating personnel walk from machine-to-machine is eliminated – total KWH consumption is reduced.

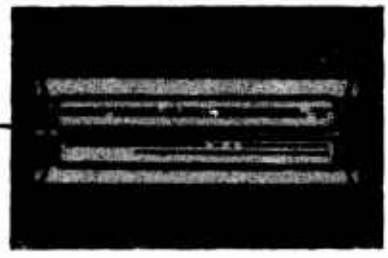
Load Cycling—Using this program, the Delta can cycle heating, ventilating and air conditioning equipment on a "duty cycle" of 80 or 90 percent of daily operation (example: run fans only 50 minutes out of each hour) to provide additional substantial energy savings.

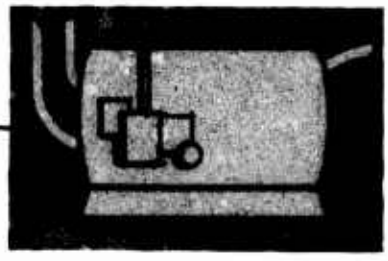


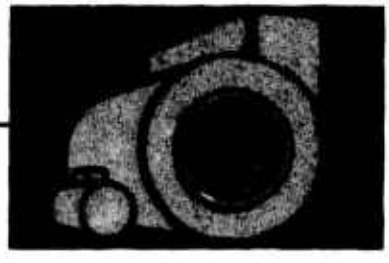
DEMAND METER



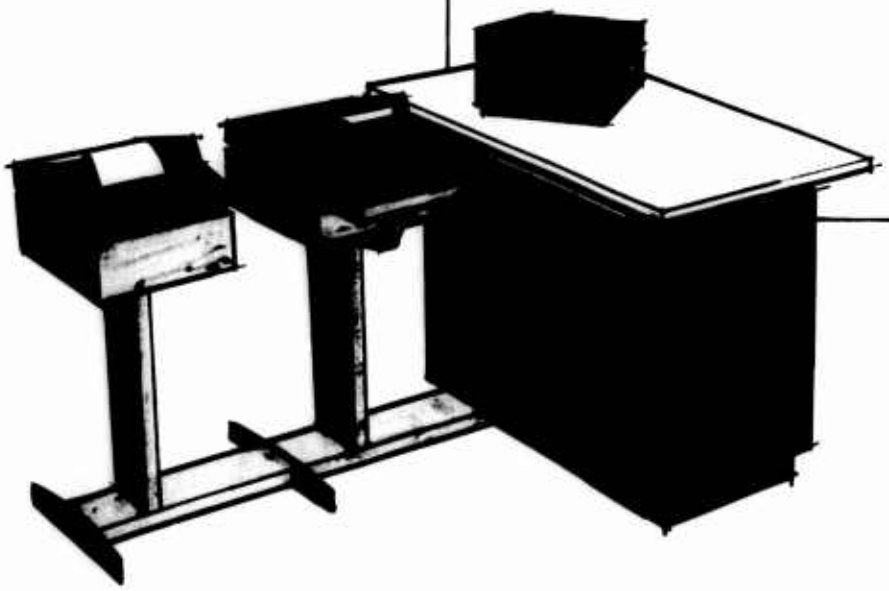
SHEDDABLE LOADS







A Delta 2000 energy management system, typically, ties all electrical/mechanical equipment together. Fans, pumps, boilers, chillers, lighting are started and stopped – automatically so you maintain an optimum on/off schedule for these units. Loads are shed – automatically – to keep you below your previous peak demand level.

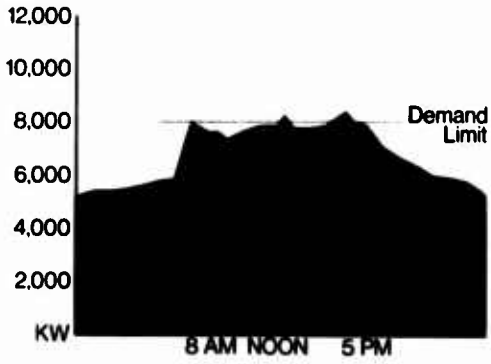


emand Peaking

Reduce electric demand charges through load shedding . . .

- Constantly monitor electric usage
- Forecast demand peaks
- Automatically shed low priority loads to avoid creation of new peaks
- Automatically restore loads sequentially after peak periods
- Override or interrupt start schedules temporarily to avoid peaks

Automatic load shedding controls electric energy usage to avoid creation of new cost-penalizing peaks. The Delta 2000 energy management system monitors usage, forecasts peaks and turns off low priority electric loads if new demand peaks are imminent. Loads are automatically turned back on when peak period is over.



ONE RESPONSIBLE SUPPLIER

Honeywell gives you a complete turnkey job. Everything. You deal with just one, totally responsible supplier. We furnish all sensors, actuators, controllers, central processing hardware. We install the complete system; check it out – as a total system. Train your operators.

When we hand you the keys to a Delta 2000 energy management system, you can be confident the system will work – as specified.

NO HIDDEN COSTS

Price, naturally, varies on a per-job basis, depending solely on scope. But rest assured, the price we quote is competitive. More important, it's *complete*, with no hidden charges for installation or programming.

The Delta 2000 system can be purchased outright or leased—whichever is best for you.

FAST RETURN ON INVESTMENT

By performing these energy management functions automatically, Delta 2000 saves enough in energy and manpower to pay for itself in one to two years . . . with savings increasing year after year as the cost of energy and labor escalates.

RUN A FINE TUNED BUILDING

Delta's modular design makes it easy to expand into other key areas of building operations:

- Early warning of mechanical problems are annunciated at the central console.
- Temperatures, pressures, flows and other "vital signs" can be read out at the console to assist management in the smooth operation of the building.
- Thermostatic control points and ventilation can be adjusted at the console to let building operations respond quickly to changes in weather and occupancy.
- Fire alarm and sprinkler systems can be monitored to provide better life and property protection.
- Access control, closed circuit television, patrol tour and intrusion alarm systems can be integrated into the Delta 2000 to improve building security.

❖

Call your local Honeywell Commercial Division sales representative to obtain a building energy survey form. Potential savings in these areas may be obvious after you and your staff complete the form and make an energy management investment evaluation with your Honeywell Representative.

Run a fine tuned building

Honeywell

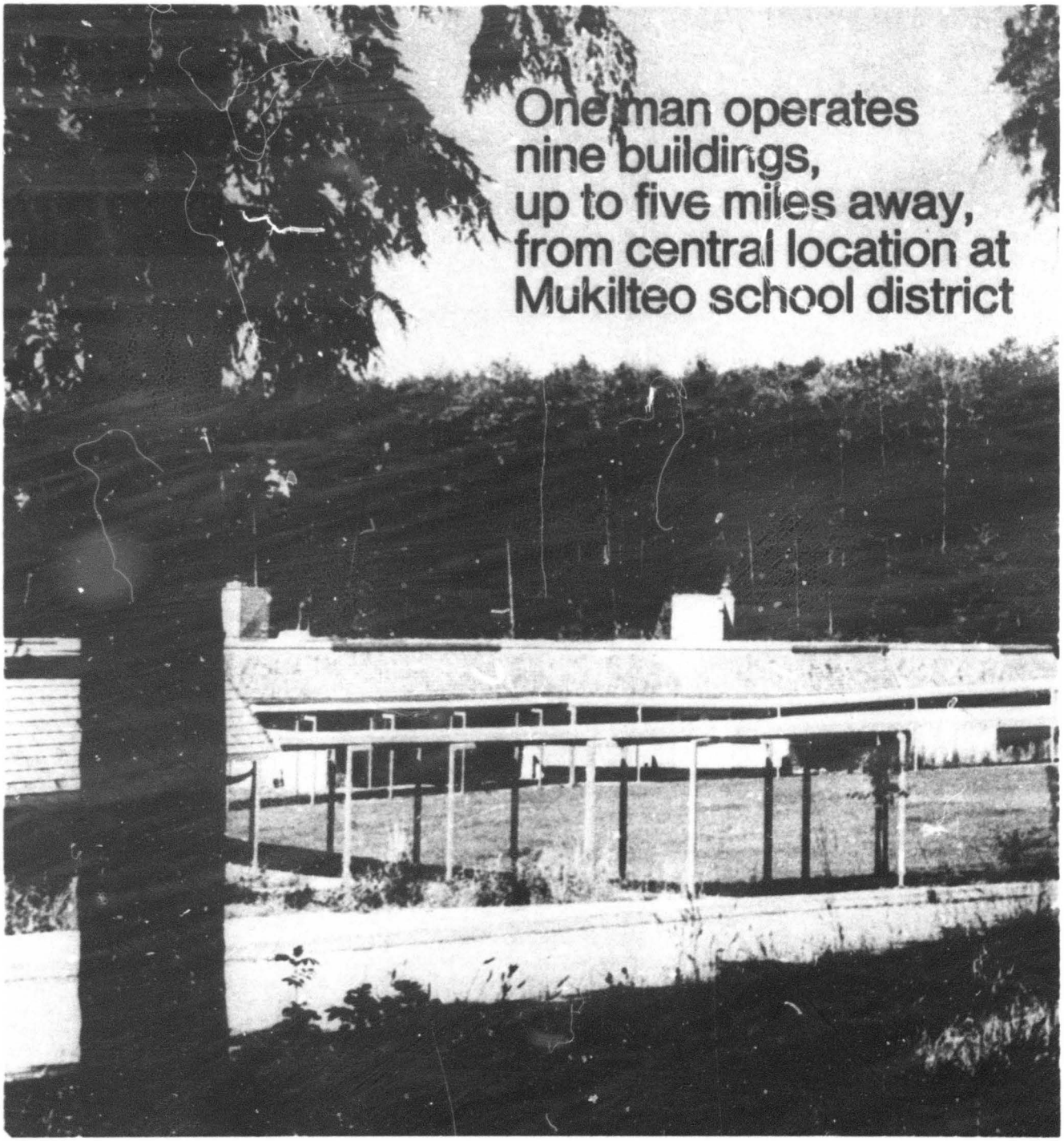
Commercial Division

Honeywell Plaza
Minneapolis,
Minnesota 55408

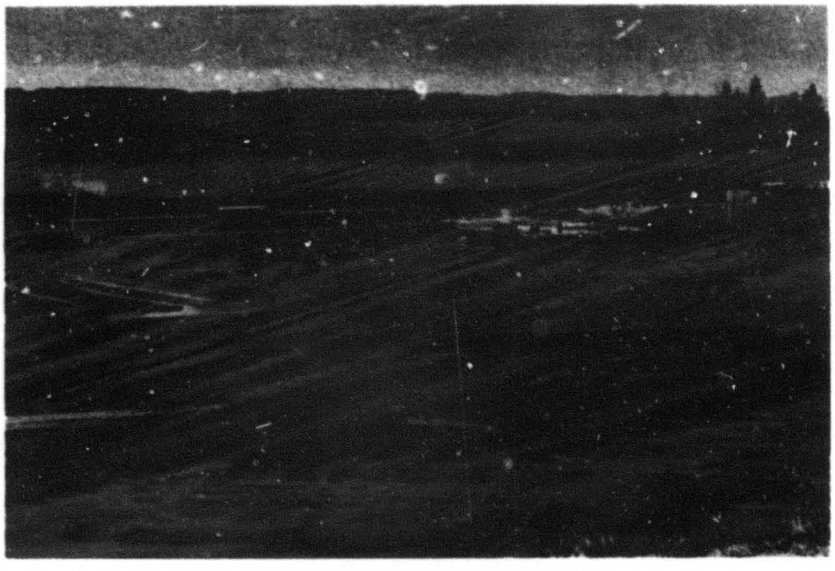
In Canada:
740 Ellesmere Road,
Scarborough, Ontario

54-0718 1/75

Mukilteo School District



Mukilteo



Olympic View Middle School has more than 900 students in three classroom buildings. All mechanical equipment is controlled from the operations center five miles away.

One man operates nine buildings, up to five miles away, from central location at Mukilteo school district

When Mukilteo School District put Honeywell central automation in their new Explorer K-8 school, they gained the added benefit of being able to control the entire school district from one central point.

It allowed Maintenance and Operations Supervisor Ted Hammond to gain tight round-the-clock control over many buildings scattered throughout the district — without leaving his office. Operating the remote buildings via leased phone lines, the Honeywell Delta 2000 turns mechanical systems on or off, monitors for abnormal operation, controls temperatures, warns of fire or smoke and detects unauthorized entry.

"Although we have about 5,000 students at present, we are still getting significant population growth," Hammond stated. "The trend is expected to continue for some time."

"We found that Delta could do a lot more than control our five new buildings."

By combining fire, security and control systems in the new Explorer complex, and the new Educational Community Service Center, the school district found many dollars could be saved with a Delta 2000 Central Automation System.

Hammond found he would be able to take advantage of the Delta 2000 to control other buildings in the district also. Delta provides operational control and security for three buildings in the Olympic View Middle School, the Fairmont Elementary School, the new Education Community Service Center and will handle four buildings in the new explorer campus. Although the nine buildings are up to five miles distant, they are all controlled and monitored from the district's Maintenance and Operations Center with a level of efficiency never before possible. "The significant fact is that we are able to add five new buildings with no increase in mechanical maintenance staff," Hammond said.

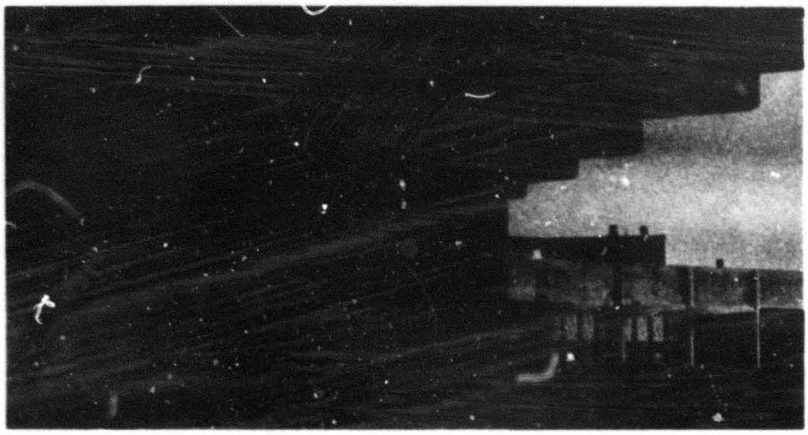
The Delta 2000 uses its electronic brain to continuously monitor and control conditions throughout each building. And, each building is different. A wide variety of central plants, rooftop air handlers, unit ventilators and controls are used. Local sensors monitor and control boilers, chillers, pumps, fans and doors. The information is fed back to the local Honeywell Data Gathering Panels (DGP's). These are continuously interrogated by Delta via leased phone lines. "Whenever an abnormal condition occurs, we know about it within seconds," Hammond stated.

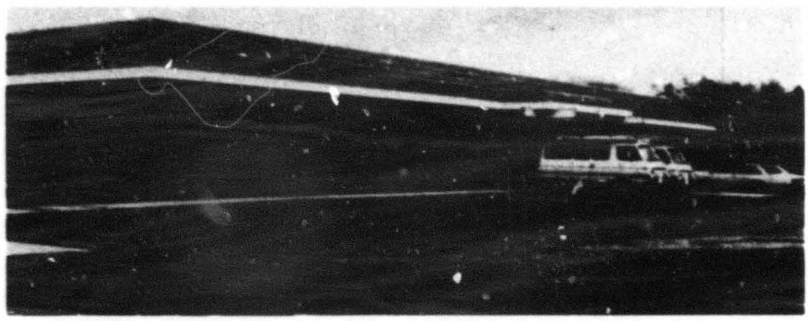
Mechanical control

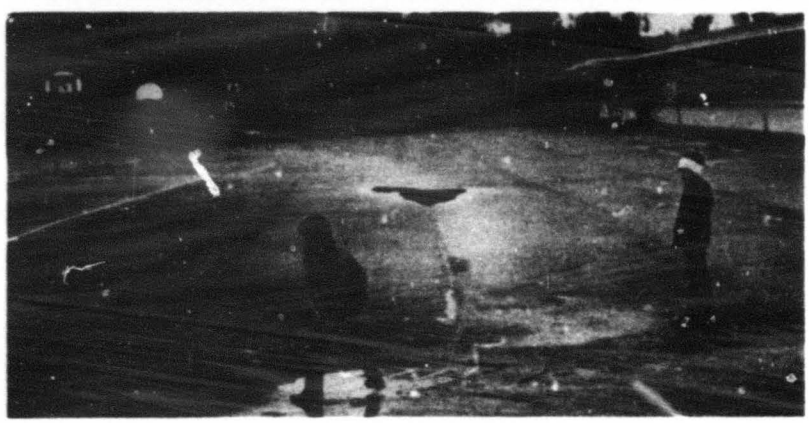
The Educational Community Service Center and nine school buildings are controlled by the Delta automation system. More than a thousand local points are controlled or monitored in the system, including temperature, pressure, humidity and ventilation. Remote mechanical equipment is stopped and started from the central console. Much of the mechanical equipment is on timed, automatic program. Total running time is logged in for the more critical mechanical equipment, so preventive maintenance can be scheduled more accurately.

"When our repair man arrives at the site he can request virtually any machine operation over the intercom."

When mechanical equipment alarms come in, Hammond, his office assistant Margery Tiessen, or one of the maintenance men can interrogate other sensors in the area to pick up more information. In this manner, a lot of trouble-shooting work can be





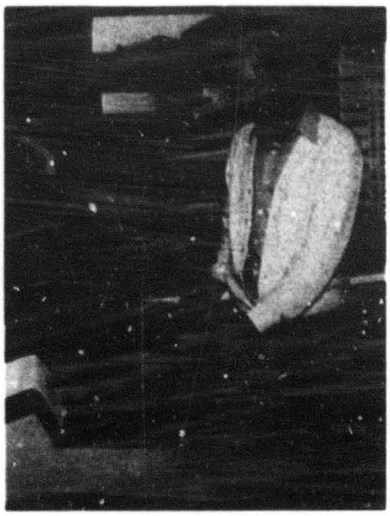


The new four-building Explorer K-8 campus (top), the Educational Community Service Center (middle), and Fairmont Elementary School will be controlled from the centrally located operations center. Gradual expansion will bring the rest of the school system on line in the near future.

done without even leaving the control center. "When our maintenance man arrives at the site, he can request virtually any mechanical operation over the intercom," Hammond related. "It provides an added measure of safety, too," he added, "since it allows our men to have constant contact with the office."

"It has given us a level of security never before possible."

"We were able to integrate building security and life safety functions with very little additional expense. It has given us a level of security never before possible," Hammond noted. Perimeter detection, inside motion de-



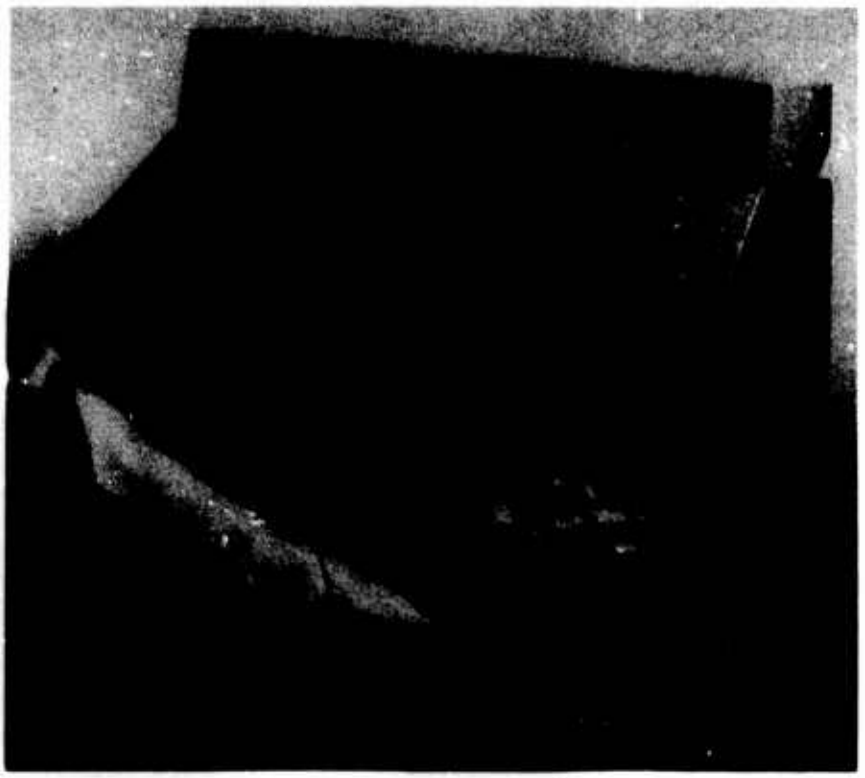
Ted Hammond, Supervisor of Maintenance and Operations, runs remote mechanical systems from the Delta 2000 control. The graphics module (rear), projects floor plan, system diagram or instructions for each group, system or sub-system. The control console, (center), addresses any location desired, displays the condition (on, off, temperature, alarm, open, close secure, etc.) and with the push of a button, commands any change desired. "It lets us diagnose problems miles away before we even send anyone out," Hammond stated.

tection and remote secure-access switching make school break-ins a lost cause. Even highly skilled professionals would have trouble since all signal transmission is by high-speed, digital code.

Smoke and heat detectors located throughout the buildings are combined with manual pull stations to provide the earliest fire warning possible. They activate local evacuation alarms and send the alarm into Delta for prompt action. Delta's automatic printer keeps a record of all alarms and change of state operations.

"Without automation, I would have needed four more men just to maintain our understaffed condition."

"Having spent several years as a school board member myself, I've found the biggest expense I can save the school district is labor," Hammond



When a point goes into alarm, the operator's display flashes the location and problem. The printer raps out a hard copy of the same information plus time of day. Complete status summaries of all systems, individual system, alarm summaries, total running times and other management information tools are printed out with the touch of a button.

confided. "Without automation, I would have needed four more men just to maintain our understaffed conditions," he added. "Now we're saving $50,000 a year on this item alone," he declared.

"When you have to drive several miles to make repairs, it's nice to know what's wrong, so you can take the right equipment along the first time."

Delta is also helping Hammond raise the level of performance for his staff. "It tells us the relevant facts about our buildings, so we can plan our activities in a more rational manner," Hammond remarked. "It appears that our present staff will be adequate now that the automation system is cutting down on the footwork," he added.

"It used to take us a couple of hours to isolate a problem. Now Delta can usually pinpoint it for us in just a few moments," Hammond declared. "When you have to drive several miles to make repairs, it's nice to know what's wrong so you can take the right equipment along the first time." He has also installed a manpower status board in the central control room. At a glance he can tell where each of his men is throughout the system.

"We expect about 15% energy savings by eliminating unnecessary run time..."

By putting major mechanical systems on Delta's automatic start-stop programs, Mukilteo School District gains two ways. "We expect about 15% energy savings by eliminating unnecessary run time, and we get extended equipment life," Hammond said.

Plans call for tying the remaining four Mukilteo schools, plus all future additions, into the Delta 2000 central controller, via leased phone lines. Some will be up to ten miles away. Hammond pointed out that distance is no problem. "Later, we hope to be able to share our system with other nearby school districts," Hammond related. "This will allow them to realize the same benefits we are getting, especially the small districts that couldn't afford a complete system of their own," he added.

"Delta helps us get a lot more work completed per dollar invested..."

The Delta system gives the school district round-the-clock protection — even though no one is on duty. Within seconds of a fire or intrusion alarm, automatic signals report directly to assigned officials.

Any mechanical equipment alarms cause automatic shut-down and a record is kept on Delta's automatic printer. Each morning, Hammond gets a summary of any alarms and can ask Delta for a total status summary whenever desired.

Hammond pointed out that the basic benefits for the school district include better comfort control, more efficient manpower use, faster response to trouble, increased security, and better records.

"Over the long run, Delta helps us get a lot more work completed per dollar invested," he stated. "It helps us achieve our budget and management objectives," he concluded.

Muckilteo (pronounced muck-ill-tee-oh) School District is located north of Seattle, Washington on the beautiful Puget Sound. The area is well known locally for the desirable hillside residences overlooking the Sound, and with a view of the San Juan Islands and Olympic Mountains. Nationally, it would be better recognized as the home of the giant Boeing 747 aircraft.

The school district is known throughout the state as a progressive organization that has implemented a number of effective new programs. A model school program, now being tested, offers two 15-week trimesters and a shorter 6-week mini-trimester. Plans call for a summer program that would use facilities year-round.

Another concept being developed is the K-8 elementary school that stimulates community involvement and wide use of upgraded facilities. The K-8 program brings children of kindergarten through eighth grade together in a multi-building campus so the combined school can support more specialized activities like swimming, language labs and more sophisticated teaching equipment.

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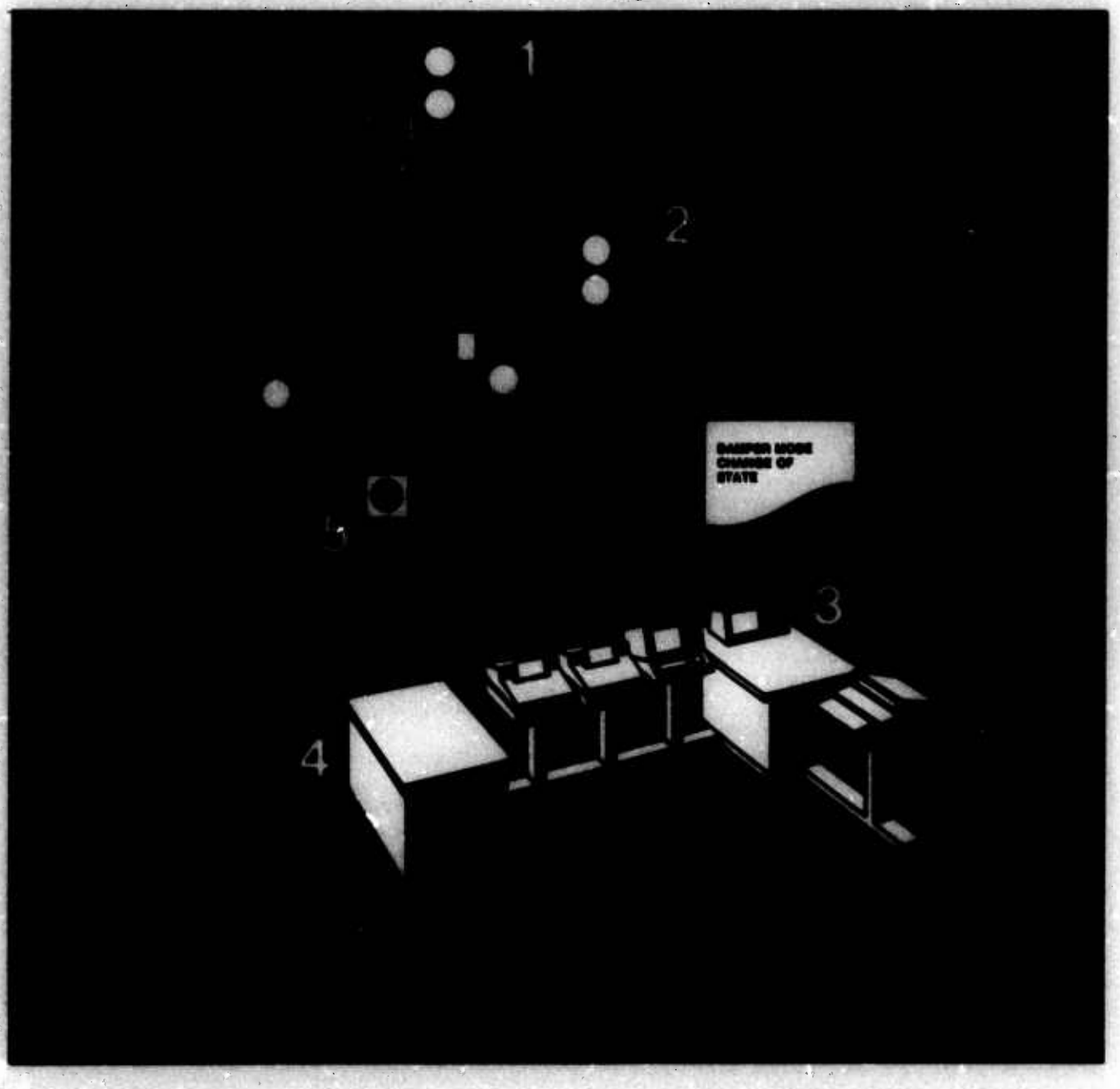
Delta 2000 Computer System

Outdoor Air/Return Air Optimization

Synopsis

This program measures total heat content of outside air and return air, compares them, and automatically positions dampers to send air having the *lowest* total heat thru the cooling coil. This reduces cooling load and makes maximum use of outdoor air for cooling when outdoor conditions permit. The end result is a significant reduction in energy consumption, and thus lower utility charges.



Outdoor Air/Return Air Optimization

Return air dry bulb and dewpoint (1), outdoor dry bulb and dewpoint (2) and on-off of each air handling system is input to computer via DELTA Processor (3).

Computer program (4) computes and compares total heat of outdoor air and return air. If outdoor total heat is *less* than that of return air, dampers may go to 100% outdoor air under local loop control. If outdoor total heat is *greater* than return air, dampers revert to minimum outdoor air position.

Computer outputs "on" or "off" commands directly to damper mode changeover switch (5) at each air handler.

Operating Sequence

Every 20 minutes an enthalpy (total heat) comparison is made between the outdoor and the return air available to a system. Three situations are possible:

Area 1— Outdoor air total heat is *greater* than total heat of return air.

Computer action *closes* outdoor air dampers, permitting maximum return air to enter cooling coil. OA dampers remain open at minimum position for ventilation requirements.

Area 2— Outdoor air total heat is *less* than total heat of return air. However, outdoor *dry bulb* is *higher* than dry bulb of return air so outdoor air would still present a larger load than return air.

Computer action *closes* outdoor air dampers permitting maximum return air to enter cooling coil. Minimum OA dampers remain open for ventilation requirements.

Area 3— Outdoor air total heat *and* dry bulb temperatures are less than total heat and dry bulb of return air.

Computer action enables the local-loop discharge air controller. Normally, this controller will then sequence outdoor dampers and cooling coil valve on a rise in temperature.

Printouts

When computer action enables local-loop control, printout will be:

0845 034-AC02-02HS OPT OA

When computer action *closes* outdoor air damper, printout will be:

1015 034-AC02-02HS OPT RA

Input-Output Summary

For each air handling system utilizing this program, the following *inputs* will be provided:

— 1 Outdoor dry bulb temperature
— 1 Outdoor dewpoint temperature
— 1 Return air dry bulb temperature
— 1 Return air dewpoint temperature
— 1 Fan Status - on or off

Normally, *one* outdoor air measurement will be provided per building, except where size or configuration would permit *different* OA intake conditions.

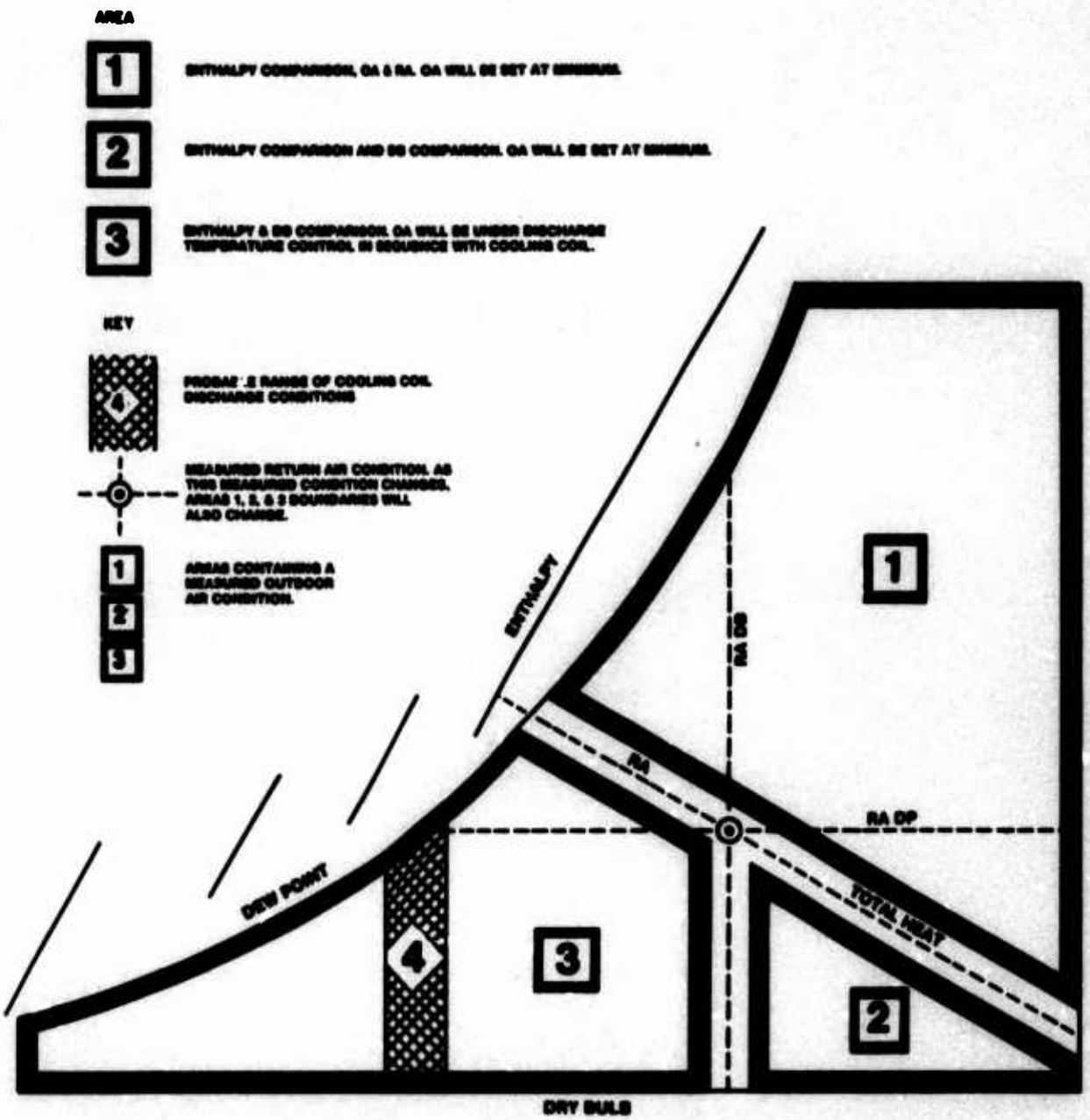
Return Air plenums supplying several air handling systems will normally have *one* set of DB & DP sensors.

Stored tables in computer memory convert dewpoint and dry bulb measurements to a number representing total heat (enthalpy).

Outputs for each air handling system include:

— 1 On-Off module to change damper mode from local-loop control to RA
— Printouts listed above

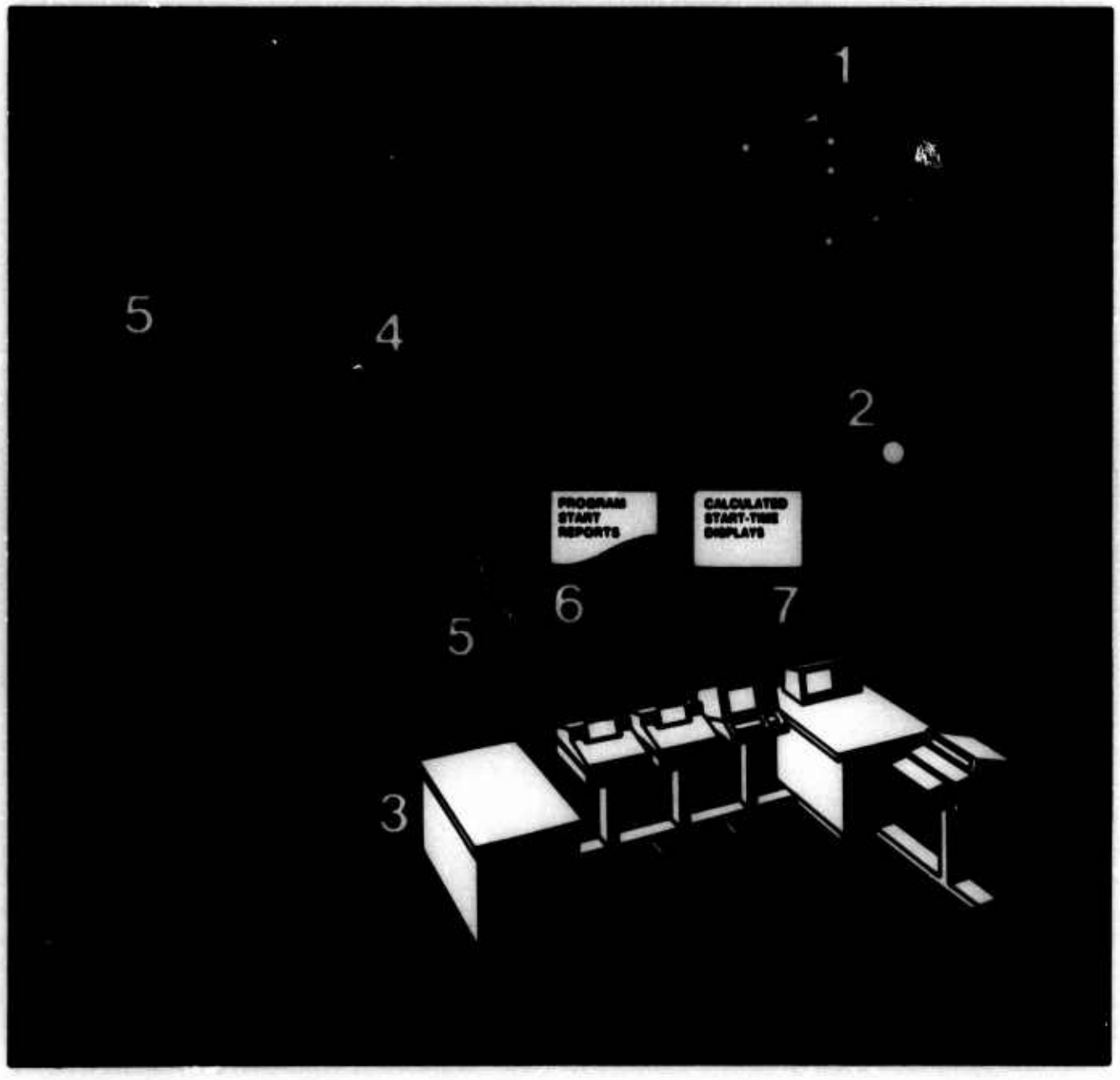
OA-RA Enthalpy Selection Computer Program



Start-Time Optimization

Synopsis

This program operates every morning prior to occupancy of a building or zone. It measures indoor and outdoor conditions and computes the latest start-time for heating or cooling equipment that will result in normal comfort conditions by the time of occupancy. The purpose of this program is to achieve desired comfort conditions (at time of occupancy) for the least possible cost.



Start-Time Optimization

Computer program (3) calculates difference between actual and desired zone temperatures (1) and multiplies this by a factor that varies with outdoor temperature (2), resulting in the required number of minutes before occupancy for starting the air conditioning system.

Start command is sent to the air conditioning system (4) via standard DELTA remote panels. Other equipment, such as warm-up/cool-down switches (5), and pumps serving that zone (5) can be assigned using the same inputs but arranged to start, for example, 15 minutes earlier or at the same time.

Operator can request display (7) of calculated start-time for any program and printer (8) will record actual starting time for every program.

Program Assignment

The zone or system assigned to this program is also assigned to an automatic start/stop program channel, which usually corresponds to time of occupancy. For example:

Point Address	Start/Stop Channel	Start Time	Stop Time
33-PA02-01 SUF-S/S	11	0740	1800

This information when displayed via CRT, shows that on floor 33, Primary Air System 02, Point 1; is a supply fan assigned to a start/stop function in the program. It is assigned to start/stop channel 11, which has a start-time of 7:40 AM and a stop-time of 6:00 PM.

7:40 AM (occupancy time) is the *latest* "on" time required, regardless of inside or outside temperatures.

Start-Time Calculation

Every 10 minutes, starting at least 4 hours prior to occupancy, outdoor temperature and space conditions in the zone(s) served by "PA02" air handling system are measured, and a new calculation made. This allows the start-time to be delayed—depending on the current space temperatures, the temperature desired and outside air temperature. An increment of time is selected from a table depending on the absolute difference of the temperature conditions mentioned. This increment of time is then multiplied by a factor, which may be different for each optimized start/stop program. This modified increment will decrease the start-time according to the calculated lead time necessary for this particular start/stop program.

Each program has individual multiplier values allowed and are all changeable by the console operator. A multiplier number of 0 means program will start at occupancy time. The above multiplier values may assume values from 0.01 to 9.99. The value is entered, and can be changed, through the CRT keyboard.

For optimum start-time programs, the start-time is computed by multiplying the time increment by the multiplier value stored. This computed value is then subtracted from the occupancy time for the start/stop program, and the result is used as the start-time.

The calculation results may be displayed on request via CRT. For example, at 0360, operator wants to know what time a system fan will start. He addresses the point and reads on the CRT:

33-PA02-02 SUF-CA 0710

Inputs to Program

From 1, 2, or 4 indoor temperatures in a zone (or building) are measured per assigned program. If desired, more points may be averaged via the calculation programs and results stored in a single address. Any space temperature may be shared between several optimum start channels. In addition, one outdoor DB temperature is measured.

Operator inputs to program via CRT include:

- Start Channel assignment
- Start & Stop Channel Time assignment
- Start-time Channel multiplier
- Assignment of systems having required inputs to an Optimum Start Channel.

Outputs from Program

Any number of points may be assigned to a channel. Each channel has a unique set of inputs and will calculate start-time.

Outputs are:

- Automatic Start/Stop Command to assigned points.
- Printout that channel has started.
  Example: 0710 OPT TIME S/S PROG 11 ON
- CRT display of calculated start-time.
- Standard start-time channel data printouts.

Auxiliary Functions

Systems having a "warm-up/cool-down" circuit (for example, to prevent use of ventilating air or electric reheats when unoccupied) can be programmed so as to always be in the "warm-up/cool-down" mode until occupancy, regardless of the time the optimum program actually starts the system.

Systems having auxiliary pumps, chillers or boilers that are required to start in advance of the fan system (20 minutes, for example) are assigned to optimum start channels having the same calculation inputs but with a fixed (latest) start-time set 20 minutes earlier.

Stop-Time

No calculations are performed to modify the time a channel will stop.

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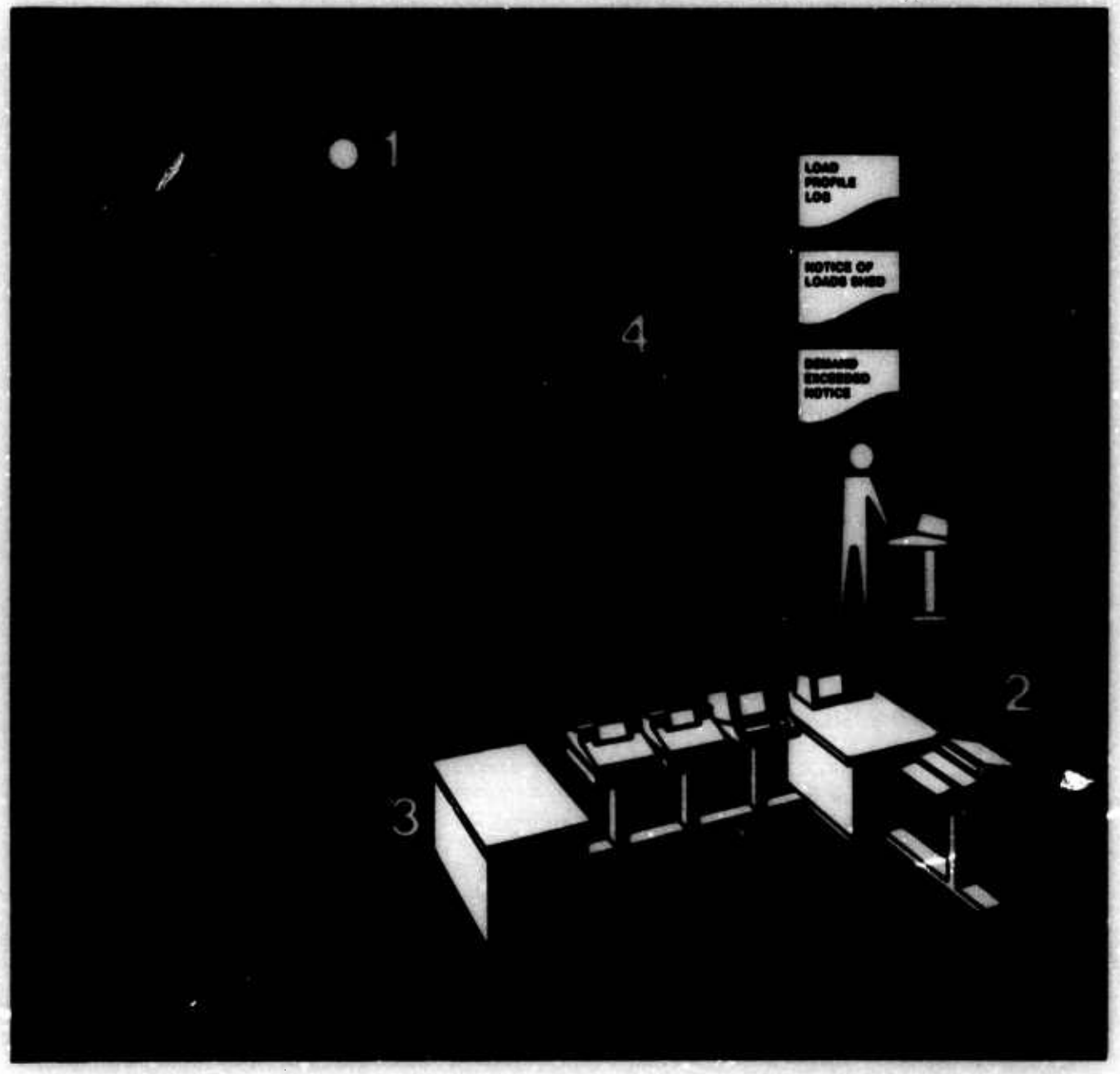
Delta 2000 Computer System

Electric Demand Forecast, Profile, and Load Shedding

Synopsis

- Electric energy (1) is measured by electric utility company meter and input into computer via DELTA Processor (2).
- The program (3) extrapolates power used at 3 minute intervals and predicts and prints out (4) if previous demand will be exceeded in spite of load shedding program.



Electric Demand Forecast, Profile, and Load Shedding

- The program has a table of 2 groups of loads and sheds group 1 first, then group 2 on a rolling priority basis. Group 3 is also provided which can be shed only by the operator as it could include critical loads. A total of 30 loads may be assigned to Groups 1 and 2, 15 per priority level.

- The computer outputs "stop" commands to various electric loads and restarts each unit at the end of demand interval.

- Operator can obtain status of all electric loads shown in I/O Summary, as well as current and previous peaks. Every load dumped is recorded on the printer (4) and status, energy and demand values can be logged at hourly intervals (Profile log).

Electric Demand Programs

Electric Demand Definition:

Electrical Demand is the term used by public utilities to describe the maximum rate of use of electrical energy averaged over a demand interval. Utility electrical demand charges are based on the maximum electrical demand, expressed in KW, experienced over a demand charge period specified in utility rates. Typically the demand period is one month, but it could be as long as one year.

KW demand may be defined as the KW load averaged over a specified interval of time. The demand for any given interval is that value of power in KW which, if held constant over the interval, will account for the same consumption of electrical energy as the real power. It is then the average of the real power over the demand interval.

The demand program is based upon the above most commonly accepted definition of demand, usually identified as the block interval method.

Available Programs

The programs available to measure and control electric demand charges are:

— Demand Profile
— Electric Demand Forecast
— Load Shedding

Demand Profile

The purpose of the demand profile is to:

— Identify at what time demand peaks appear
— Identify what major loads contribute to the peaks
— Suggest candidate loads for manual load shedding

The Demand Profile Log can be generated from any data file points representing electrical load by assigning a composite system consisting of the points desired to be in the profile.

On this basis the Demand Profile Log has the following features:

— Unique identification utilizing one of the seven permissible special system titles, such as "Electric Demand Profile"
— Any 30 system points assignable at time of assembly
— Available upon operator request or on a timed interval basis on logging typewriter
— Capable of display on the System CRT

Utilizing this technique, the Demand Profile Log can be tailored to suit the needs of the job.

Electrical Demand Forecast

The Electrical Demand Forecast program provides the operator with a *warning* in the form of an audible alarm and hard copy printout alarm. This alarm and printout occurs before the previous high demand for the month is exceeded and allows the operator to manually reduce electrical loads. The Demand Forecast is generated every 3 minutes and is based on the assumption that the extrapolated load trend seen at that time will continue to the end of the demand interval. If electrical loads cannot be reduced and the previous high demand is exceeded, the demand limit is automatically reset to the new high value.

Every 3 minutes, the program reads the count stored on a remote totalizer card. It computes the KW used since the last reading and assumes this incremental KW will remain constant and be applicable for each subsequent sub-interval remaining in the demand interval. It then adds this increment for each remaining sub-interval to the existing total and tests to see if the stored maximum limit will be exceeded prior to the end of the interval.

If the test indicates the maximum limit is to be exceeded, a single line of hard copy is generated on the alarm typewriter as follows:

0933 ELECTRIC DEMAND LIMIT #4 3421 KW WILL BE EXCEEDED BY 0513 AT 0945 HRS.

Operator action is discretionary based upon his knowledge of system loads.

The existing demand limit is capable of display at any time upon operator demand. Additionally, at any time, but usually at the beginning of a new demand period, the operator may reset the demand high limit to a new value based upon experience.

The maximum permissible contact closure rate of the prime metering device is five per second.

Demand Forecast Inputs

— 1 or 2 Utility Company demand meters
— Operator demand limit assignment
Example:
1545 DLM DEMAND LIMIT CHANGE 03 6430 TO 7120
↳ Operator's initials

Demand Forecast Outputs

— Demand exceeded message hard copy and alarm time
— Electric demand limit abort - hard copy messages (The "abort" message is generated from a power failure, transmission failure, or any other interruption of meter outputs on a regular basis.)

Load Shedding

The electrical load shedding program is intended to allow automatic program controlled reduction of electrical load in accordance with the extrapolated predictions of the Demand Forecast program.

The program includes provision for three priority groups of load shedding, only the first two of which are directly under program control. The third is treated as an operator discretionary function based upon program notification that manual intervention is required.

In addition, loads assigned to either priority group 1 or 2 are energized and deenergized on a rolling sequential basis—either individually or in multiple according to their tabulated total and the need of the forecast program. At the end of each interval, the program reenables only those loads which it has shut down and stores the location of the first (next sequential) load to be shed in each priority group during the following interval, if required.

If the program calculation and load shedding action is adequate to allow predicted load to fall within the maximum stored demand limit for the interval, no Demand Forecast alarm message is output. If the Demand Forecast is such as to indicate that shedding of all assigned priority Group 1 and 2 loads would not prevent exceeding the maximum limit, a dual message is output on the alarm typewriter. For example:

0933 ELECTRIC DEMAND LIMIT #4 3421 KW WILL BE EXCEEDED BY 0513 KW AT 0945
ALL LOADS ELEC. DEMAND GPS 1 & 2 OFF. ACTION NEEDED

All loads that could be assigned to load shedding are determined at the time of program assembly and their KW noted and stored. The operator can re-assign or delete any of these points to or from either group 1 or 2 but has no control of the sequence as established automatically for each reentered load by the program in the first unassigned table location.

If a load is deleted from the program by operator action, it remains inactive in the program until reentered by operator.

The operator retains full manual control of any load contained in this program. Automatic and Optimum Start-Time functions for load items of this program remain fully functional.

Normal change of status messages will be output on the alarm typewriter upon program action during shedding operations. For example:

0720 033-PA03-06 REH-SS OFF ØPT

This means point 06, a reheat zone, was shut off by the load shedding program at 7:20 AM.

Load Shedding Inputs

The following inputs may be assinged to this program:

- 15 loads* for Group 1
- 15 loads* for Group 2
- Loads* as required for Group 3
- Electric utility demand meter

*Nominal KW rating is stored for each load

Console Inputs are:

- Delete loads from Groups 1 or 2
- Reassign (only) loads to Groups 1 or 2
- Manual override (on or off) for any assign load in any group
- Manual shedding (only) for Group 3 loads

Load Shedding Outputs

- Demand forecast alarm message
- Demand forecast auto limit reset message
- Demand forecast limit reset by operator message
- Demand forecast program abort message
- Load shedding intervention request message, if load shedding is indicated
- Annotated change of status message on load shedding
- Display of existing limit upon operator request
- Display of present extrapolated demand for interval in progress
- Load shedding on-off control to 30 start/stop modules with change-of-status message if load shedding is included

Program Specifications

The electrical demand program is subject to the following conditions:

- The maximum permissible contact closure rate of the prime metering device is 5/second.
- One demand program is required for each group of one or two electric utility KW demand meter inputs. If additional inputs are required, a second program is required.
- All programs required on any given job must contain identical features: i.e., forecast, profile, shedding.
- The program is designed to function with block interval type utility meter instrumentation only.

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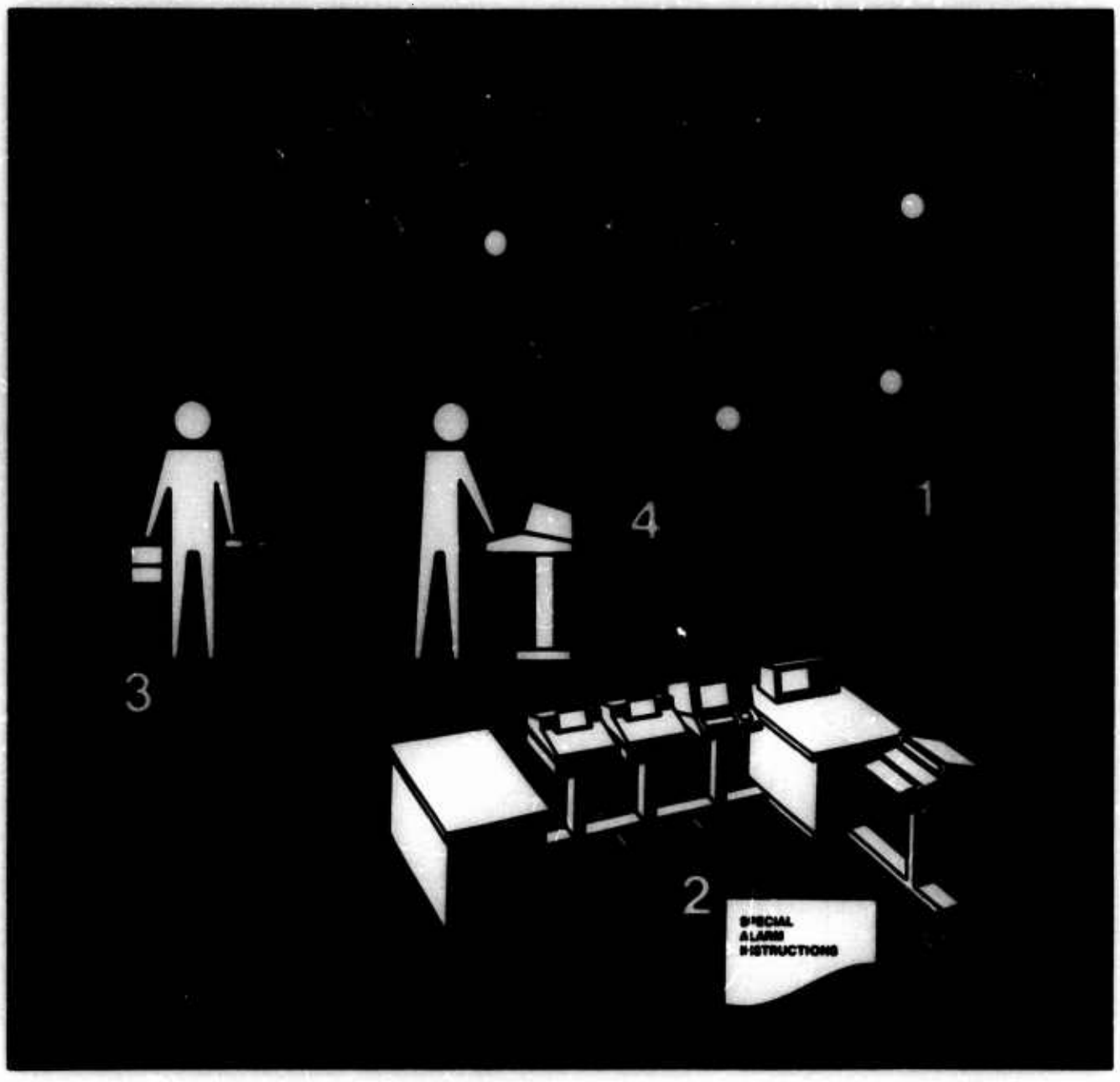
Delta 2000 Computer System

Alarm Instructions

Synopsis

This program applies to any alarm input—digital or analog, when it changes state, or goes beyond assigned limits—and causes a stored instruction to print out on the alarm printer. The purpose of the alarm printout is to give the console operator specific action instructions for



Alarm Instructions

critical alarms or instructions for urgent maintenance tasks that might be called for by the closing of an alarm contact or by an analog or calculated point going into an alarm condition.

A typical alarm instruction might be:

0706 034-HV01-10RH HI 84.0 DEG (Prints red)
PHONE SUPER. CLOSE V16A (Prints red)

The console operator having level 2 access can change alarm messages, and assignment of alarm messages to individual data points.

- Any analog or digital alarm point (1) can be assigned an alarm message (2).
- Occurrence of alarm causes a special message to print out (3).
- Console operator (4) can type in new messages and assignments.
- Provides written instructions to new operators.

Capacity

Alarm messages may be up to 60 characters in length.

Number of points that may have alarm messages assigned is a function of the memory capacity furnished.

Inputs and Outputs

Inputs are:

— Any alarm contact or analog input
— Change message via keyboard
— Change assignments via keyboard

Outputs are:

— Alarm messages printed in red
-- Record of change in message assignment
— Record of change of message

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Delta 2000 Computer System

Maintenance Instructions

Synopsis

- Any equipment (1) listed in the I/O Summary for start/stop *or* run-status indication can be specified for this program and run-time hours will be monitored via DELTA Processor (2) and stored in computer memory (3).

Maintenance Instructions

- Equipment (4) specified by the owner can be identified and stored in computer memory (3) for the calendar portion of this program.

- Program (3) outputs, once a day, a list (5) of equipment due for preventative maintenance with a brief task description. Either accumulated run-time or calendar time can generate a maintenance message.

The intent of this program is to inform the operator whenever specific equipment items are due for scheduled maintenance work, based on either:

Accumulated run-time, or
Elapsed calendar-time.

Once a day all maintenance tasks which have become due will be typed out. The message will be typed on two lines with the time interval and point identification on the first line and the corresponding maintenance message on the second. Any selected time of day may be specified for printer output of due maintenance tasks.

Each message may be individually constructed and entered into memory by the operator, using the CRT keyboard and display. Each message consists of words, abbreviations and numbers, containing no more than the specified number of characters, including any alphanumeric symbols and spaces. Any message may be changed at any time by the operator.

Any stored message may be assigned as the output message for any of three run-time intervals or calendar-time intervals for any point in the maintenance message program. Assignments are made via the CRT keyboard and display and may be displayed upon operator request. A printout will record all operator assignments on the alarm typewriter.

The maintenance messages proper (second line of copy) can have up to a maximum of 60 characters, including spaces. Number of messages, length of messages, and number of points assigned is a function of the memory capacity furnished.

The times for each equipment item are accumulated in hours by the program, with ¼ hour sampling from status inputs for running-time points and 24 HRS/DAY for all calendar-time points. The running time totalizer in memory accumulates to a maximum of 10,000 HRS or 10,000 DAYS.

Inputs to this program are field status contacts for the running-time points and 24 hours/day for all calendar-time points. Any desired points may be specified for assignment to this program and they will be incorporated into the data file. They can be specified as either "running-time" or "calendar-time", but not both.

A maximum of nine maintenance intervals each for both running-time and calendar-time are determined by the owner, but are specified for factory program assembly. Examples of typical assignments are:

Running-Time:	Calendar-Time:
1. 40 HRS	1. 1 DAY
2. 100 HRS	2. 7 DAY
3. 200 HRS	3. 14 DAY
4. 500 HRS	4. 30 DAY
5. 1000 HRS	5. 60 DAY
6. 2000 HRS	6. 120 DAY
7. 2500 HRS	7. 180 DAY
8. 5000 HRS	8. 365 DAY
9. 9999 HRS	9. 730 DAY

Typical Operating Sequence

At 0800, the following messages, for example, could print out.

MAINTENANCE LOG 0800

B03-MS01-06 PMP 14 DAY
TEST PUMP
034-PA02-01 FAN 2000 HRS
LUBE, BELT INSP
... 042-RF01-01 ROF 120 DAY

... INDICATES TASK NOT REPORTED DONE FROM PREVIOUS DAY

Inputs to Program

Following are field inputs to this program:

— Calendar-time in days
— Run-time from status contacts

Following are console operator inputs:

— Maintenance message change
— Maintenance message assignment to a point
— Maintenance task completed

Outputs to Program

Each data point can be assigned (3) three different elapsed-time periods, each with a different message. For example:

Point identity and first message after 100 hours

034-PA02-01 FAN 100 HRS
START/STOP BELT TENS. LUBE

After 200 hours, this would print out:

034 0 PA02-01 FAN 200 HRS
START/STOP BELT TENS. LUBE

After 300, 400, 500, etc. hours the above would repeat.

After 1000 hours, printout would be:

034-PA02-01 FAN 1000 HRS
START/STOP BELT TENS. LUBE
STOP & VAC. PLENUM CLN. BLADES

After 2000, 3000, etc. hours above message repeats.

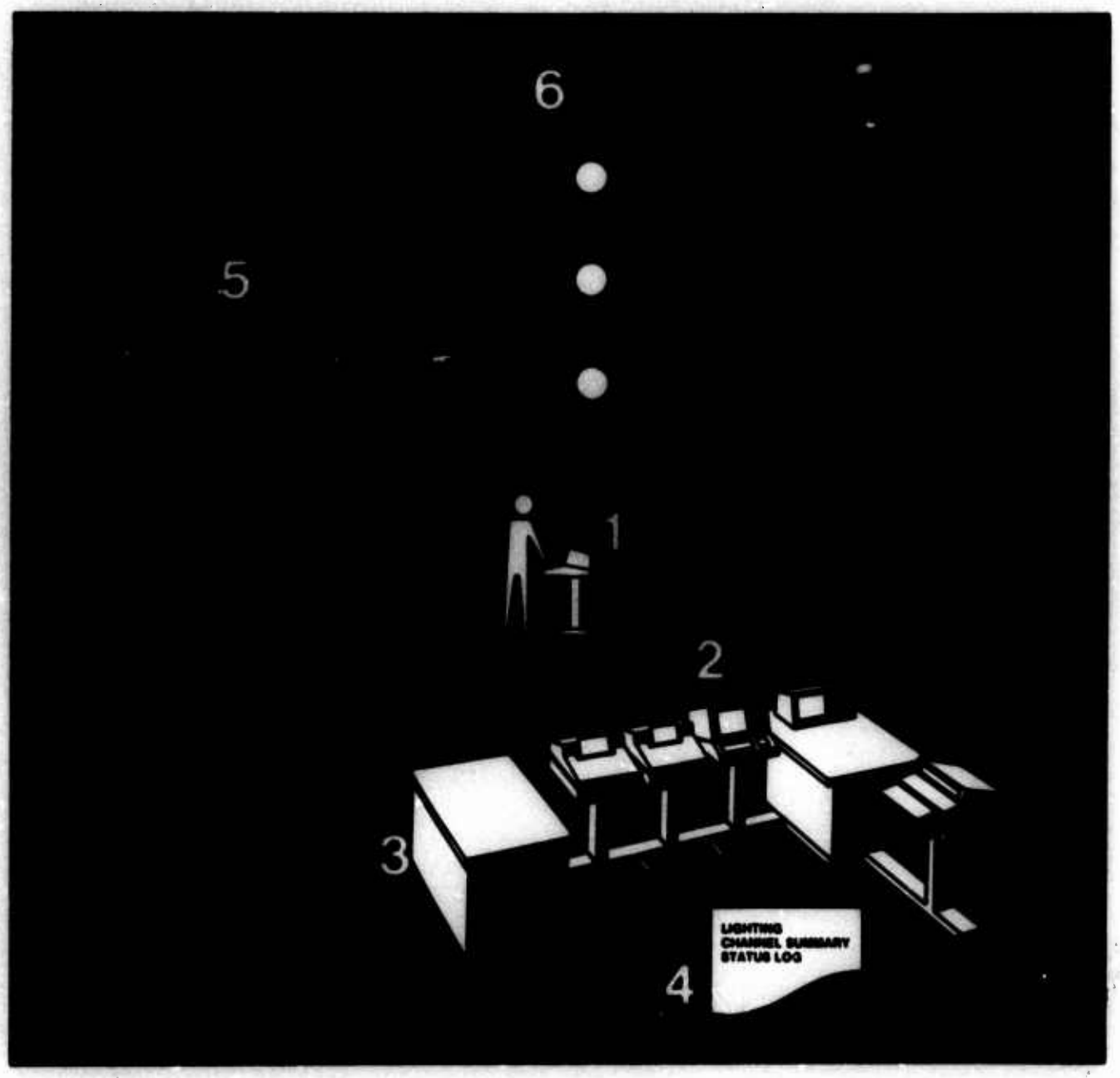
A third message could be assigned to print out a third designated interval.

Honeywell Delta 2000 Computer System

Central Control of Lighting

Synopsis

Console operator (1) establishes desired on/off times for centrally controlled lighting zones and stores these times and channel assignments via the CRT console keyboard (2). The stored program (3) generates an "on" or "off" signal to lighting zone contactors (5). "On" or "off" status (6) is fed back to computer memory (3) and used to update lighting status logs (4).



Central Control of Lighting

Central Lighting Control Programs

Lighting program control provides automatic, time-programmed operation of lighting zones on preset time schedules. On time program operation, when the H316 computer time equals a specific, stored, program time, points assigned to that program automatically switch to "on" or "off" position as the program dictates. Time delay is provided between sequential startups, thus distributing the starting surges of loads. Zones on time programs can also be operated manually at any time, other than automatic program times, simply by displaying the point number and status on the CRT and performing a command function through the keyboard to change the status.

Program numbers 35 through 49 may be reserved for lighting programs. Individual zones may be assigned to either one or two programs, thus providing two "on" times and two "off" times per day, i.e., a morning startup and an evening "janitorial program". Any zone may be reassigned from any program number to another, or dropped from timed program operation entirely.

Each time program permits setting in 24-hour format (0001 to 2400) for weekdays (W), Saturdays (S), and holidays (H). Holiday (H) represents both Sunday and holidays. For example, a zone point might be assigned to two program numbers with the following schedule:

Day	First Program (No. 09) Morning Start		Second Program (No. 10) Evening Start	
	ON TIME	OFF TIME	ON TIME	OFF TIME
W	0730	1630	1830	2200
S	0730	1300	0000	0000
H	0000	0000	1230	0630

Program times, such as those listed, may be changed at any time by simple keyboard entry.

Further, the system provides an automatic printed record of all operator changes, such as manual "on" and "off", program point assignments, and program time changes; and a record of all automatic changes, such as time program startup and shutdown. In addition, the operator can request printout of a program summary log which lists on/off times for each program number; or a single program summary log which lists a single program number, each point assigned, and the present status of each point.

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HOW TO USE YOUR DELTA 2000* COMPUTER SYSTEM SPECIFICATION DATA

This specification data sheet has two functions:

1. Specification data
2. Customer proposals

For customer proposals, you may select just the pages that describe any standard model DELTA 2000 computer system. If you wish to include an I/O summary in your proposal, it should be inserted after page 14.

Procedure –

1. For specification data covering Model 2518, use the attached specifications as is less replacement pages marked -01 located at the end of this form.

2. For specification data covering Model 2500:

   a. Locate the following replacement pages i (front cover), ii, iii, 3-4, 5-6, 9-10, 13-14, 16-17, 30, 80-81, 82-83, and 84 (back cover) at the end of this form and insert into the attached specifications. These have -01 marks in the lower left-hand corner of each page with specific Model 2500 data.

   b. Remove the same numbered pages plus 84-85 (back cover) marked -02. These pages are for Model 2518.

   c. The balance of the pages are identical for both models 2500 and 2518.

3. Destroy this sheet and any unused pages, i.e., pages marked -01 or -02.

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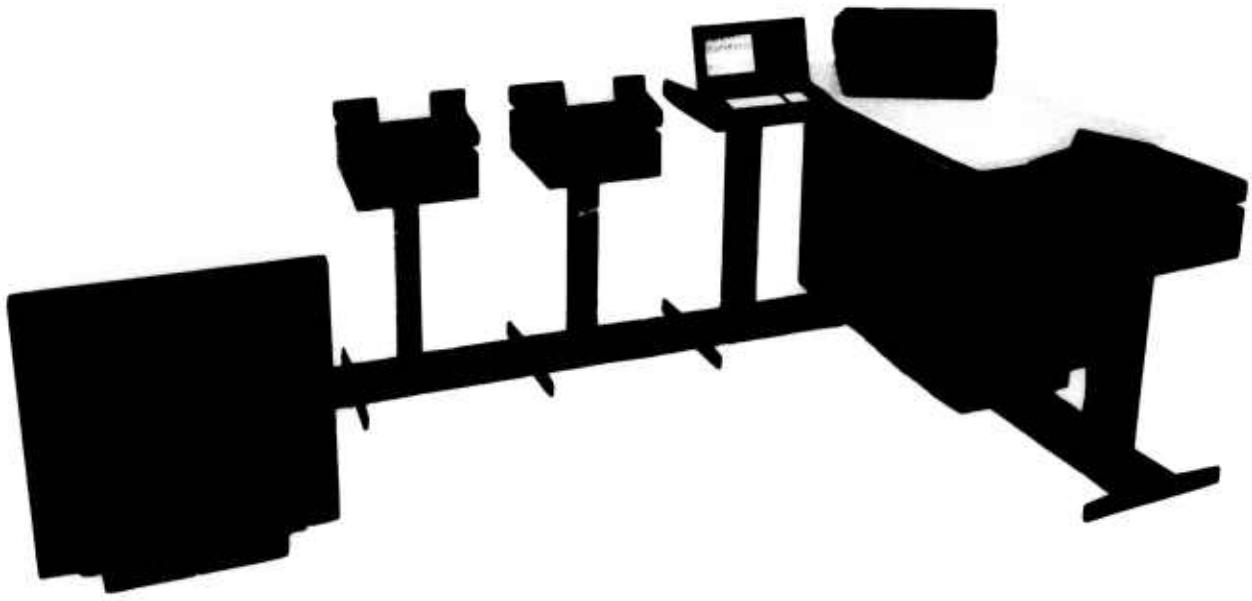
Commercial Div

△ SPECIFICATION DATA



DELTA 2000* COMPUTER SYSTEM

*Trademark

Rev. 12-73
D.F.
-02

Honeywell
Commercial Division
FORM NO. 74-1866

CONTENTS

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SYSTEMS OVERVIEW

The DELTA 2000 Computer System is a complete, modular, expandable control center that will permit operation, alarm surveillance, energy monitoring, and optimum, on-line control for mechanical and protection systems throughout a building, building complex, or locations on remote, separate premises.

- *Any Model DELTA, Starting With the Smallest, Can be Used as a Start-Up System*

Owners who now have, or soon plan to buy a small DELTA system, will already have the central processor, transmission system, and remote panels needed for a complete computerized system. Owners buying a DELTA 2000 Computer System can now anticipate early delivery of the central processor, transmission system, and remote panels so that centralized control of parts of the building or building complex can begin as soon as remote panels and sensors can be wired up.

- *Utilizes the Standard DELTA for Central Processing, Scanning, and Digital Transmission Facilities*

This feature assures that every Honeywell field office is capable of engineering, installing, and checking out the DELTA central processing and data gathering portion of the system without installing or debugging any software. After checkout, common and routine maintenance procedures for the DELTA central processing and data-gathering components can be handled by previously trained personnel.

- *Leased-Line Operation Over Any Distance*

Since all DELTA systems have built-in, leased-line capabilities, DELTA 2000 Computer Systems also utilize this same capability for data-gathering from, and supervisory control to, any distant location.

- *All Digital Data Transmission Including Analog Values and Set-Point Information*

This feature provides a low-cost means of converting every type of analog sensor signal to digital pulses before transmission to the central processor. This engineering breakthrough, which was the key to the success of the original DELTA concept, is even more important to systems using computers. Interference from electric power lines and noise spikes caused by any electrical disturbance cannot slow down or degrade the digital transmission used for every analog sensor in the system.

- *Fully Modular for Expansion of Capacity and Functions*

This applies equally to the hardware, software, and application packages for the system. For example, extra communication channels can each add up to 100 remote systems. New data gathering panels can be installed, wired, and checked out without interrupting operation of the central console. Software application packages and the basic software executive handler are designed so that new packages can be easily patched in to the master tape at any time.

- *H316 Real-Time Central Computer Can be Furnished With Initial Project or Added Any Time Later*

The procedures for field application engineering; ordering of hardware, software, and application packages; hardware checkout; software checkout; and acceptance procedures are done in the same sequence regardless of whether the computer is installed early or late in the progress of the building or building complex startup. Every DELTA central processor shipped is equipped to accept the necessary computer and CRT interface buffers at any time.

- *DELTA Central Processor Controls All Scanning and Communications–H316 Real-Time Central Computer Used for Calculations, On-Line Control, Management Information and Operator's Communications*

Routine communications with remote systems, continuous alarm scanning, and digital-pulse-to-analog engineering unit conversions, are done within the DELTA central processing unit which has the added benefit of providing continued operation with or without the computer operating. The H316 computer unit and associated core or bulk memory is used where it can do calculations, logic analysis, storage of special messages, management information routines, programs, and alarm limit comparisons without the burden of the routine housekeeping tasks delegated to the DELTA processor. This allows ample computer time to handle the most sophisticated, on-line programs when they are added.

- *CRT Console, Projectors, Printers, for Easy Man-Machine Interface*

The operator's CRT console, systems graphic projector, and printers are located adjacent to each other to provide, on a systems basis, CRT display of all system data, a projected graphic, and hard copy for all changes initiated either by field events or by the operator. Great care has been taken so that system and point addresses, mnemonic codes, and English titles for logs, displays, and graphic projection all agree. Finally, the information is presented so that it is instantly understandable to the console operator without decoding or looking up any reference materials.

- *All Commands Displayed on CRT Before Execution*

Every address, supervisory command, and request for information from the system appears first on the CRT display screen. This allows the operator to be sure he is making the request he intended. Further, all invalid addresses or other requests cause the word "INVALID" to appear blinking. Finally, when the operator is satisfied that the address and function selected are 100% correct, he may execute the request by pushing an appropriate button.

- *English and Mnemonic Displays and Printouts on CRT and Printers*

Complete English words are used where they will not waste printer paper or space on the CRT screen. Mnemonic codes, easily remembered by the operator, are used where it is desirable to present condensed and repetitive information, such as addresses, engineering units, and other conveniently abbreviated data. Critical information, such as emergency alarm-action information, is always printed in English.

- *27,000 Point Capacity*

Extra channels in the processor can provide communication with as many remote systems as needed. Restriction of H316 usage to calculations, and other routines typically applied to a selected group of inputs and outputs, assure that throughput of the computer will not be impaired regardless of point expansion. Data files where individual points are kept track of can be expanded easily through the use of bulk memory.

- *DELTA Central Processor and Startup/Backup Console Fully Operational When H316 Shut Down*

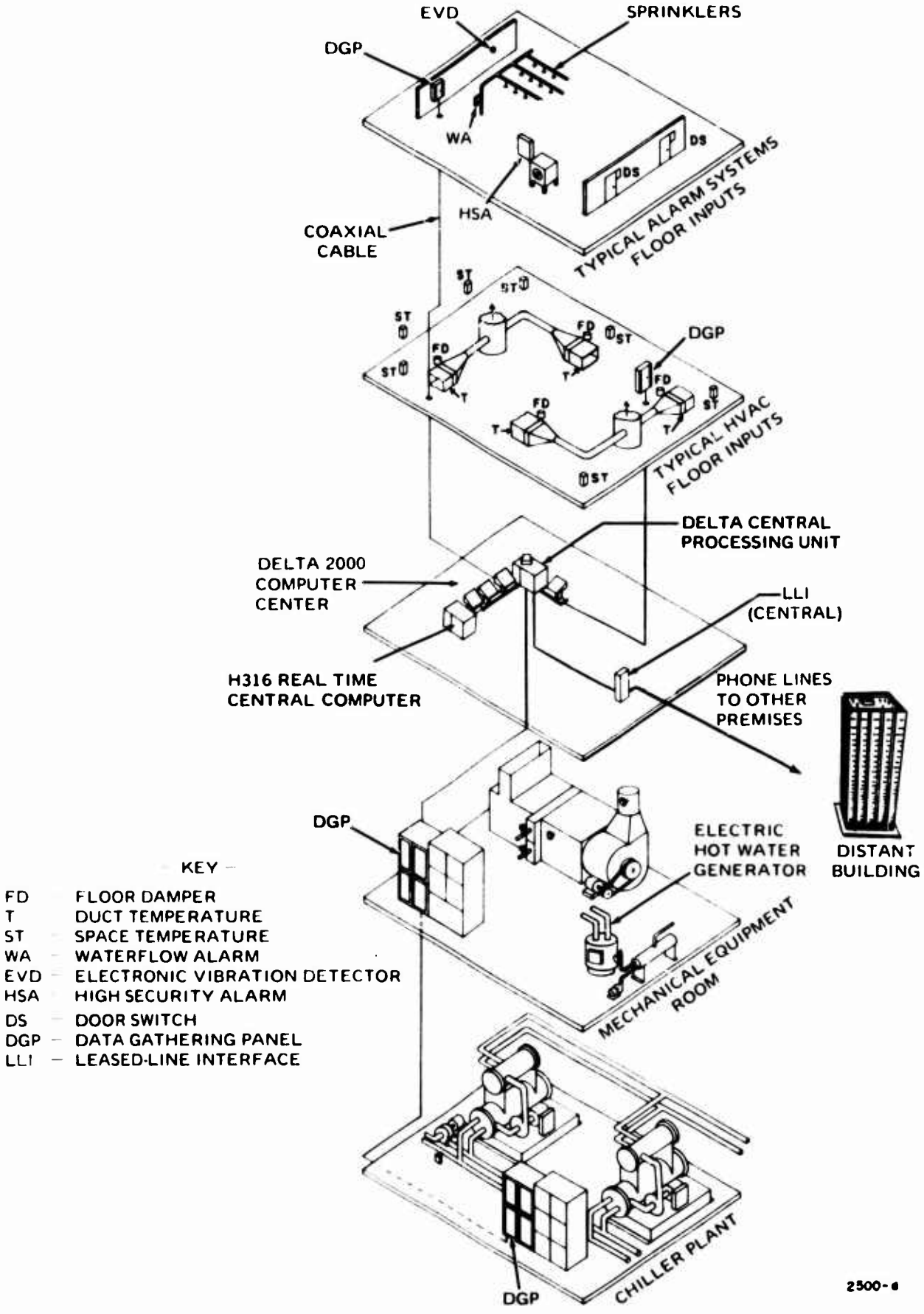
This feature allows addition of new software routines and application packages to the computer without impairing the alarm detecting and manual supervisory control of all connected systems and points. It also allows a complete operational check and verification of every input contact, analog sensor, and output module (such as start-stop) before any computer software or application routines are installed. This makes the software installation easier since all field generated data has already been tested and proved correct. Finally, the DELTA processor can be shipped early and used to operate the building as soon as remote sensors, panels, and coaxial cable is wired up.

- *Energy and Cost Control Application Package Fits Any Central Plant*

This standard, universal, application package is designed to monitor use of energy and dollars used by chillers, boilers, air-conditioning, and lighting systems in any building, whether the energy source is fossil fuel, electricity, or purchased steam. In addition, it permits tracking of energy input to chillers or boilers with energy output in the form of chilled water, hot water, or steam so that managers can set standards of performance and continue to check daily operation against those standards.

- *Standard Software, Standard System Architecture, and Full Documentation with Broad Base of Systems Engineering Skills from Any Honeywell Location*

The DELTA 2000 Computer System is the first in our industry to accomplish a standard set of software and application packages that can universally apply to any building mechanical system. It is also the first system to use the same architecture for all automation needs from the smallest to the largest building installation. And it is the first to provide fully documented software packages including detailed sequence of operation, logic flow charts, program listings, and master punched tapes. This documentation not only lowers the cost of each project, but assures continuity of programming support, independent of the systems analysts or programmers that originally designed the system.



KEY

FD	–	FLOOR DAMPER
T	–	DUCT TEMPERATURE
ST	–	SPACE TEMPERATURE
WA	–	WATERFLOW ALARM
EVD	–	ELECTRONIC VIBRATION DETECTOR
HSA	–	HIGH SECURITY ALARM
DS	–	DOOR SWITCH
DGP	–	DATA GATHERING PANEL
LLI	–	LEASED-LINE INTERFACE

DELTA 2000 COMPUTER SYSTEM
– SYSTEMS OVERVIEW –

74-1866

SYSTEM COMPONENTS

DELTA CENTRAL PROCESSING UNIT

The Central Processing Unit (CPU) with its Startup/Backup console described in the following performs the startup, backup and remote, data-gathering functions for DELTA 2000 Computer Systems. The CPU contains a high-speed analog and digital scanner which serves as a continuous message center between the remote, data gathering panels and the H316 input/output bus. Basically, the central processor:

- Sequentially interrogates each remote data gathering panel (DGP) and transfers all system and point data to the H316.
- On command from the H316, outputs commands to remote points requested by the operator's keyboard or the internal computer program.

The CPU also contains a standby programmable memory, printer controls, projector controls, and input/output access for Startup/Backup console operation.

STARTUP/BACKUP CONSOLE

During startup, before the H316 real-time central computer is installed, and later during periods when the H316 is turned off, the Startup/Backup (SU/BU) console may be used to acknowledge alarm and operate remote start-stop and CPA/DPA modules. Remote intercom stations may also be operated. All operations are via the CPU and remote data gathering panels when the H316 is off. The Startup/Backup console also permits operating the system graphics projector, requesting log printouts, and accessing the programmable memory for analog alarm limit and start-stop program alterations.

H316 REAL TIME CENTRAL COMPUTER

The H316 Real-Time Central Computer (RTCC) unit includes a computer mainframe, core memory, a programmer's panel, a peripherals interface, and provision for a future, bulk memory unit.

Hardware features

General Purpose, parallel access
Automatic restart
16-bit word size
72 instruction complement
1.6μ-sec speed

Software features -

Receives data from CPU and remote points at up to 1000 points per second.
Operates the CRT display and receives keyboard commands.
Controls printout of all alarms, messages, and logs.
Performs all calculations.
Operates on-line control programs via the remote Data Gathering Panels (DGP's).

H316 MAINFRAME

COMPUTER CRT CONSOLE

The computer CRT console consists of a computer-input, typewriter-style keyboard and a computer output, alphanumeric CRT display. The input keyboard contains all the controls to start and stop remote equipment, position remote control point adjustement (CPA), and damper position adjustment (DPA) modules, and to operate remote intercom stations. The keyboard is also used to acknowledge alarms, adjust analog alarm limits, change programmed start-stop times, operate the systems graphic projector, and to request logs on the logging printer. The CRT display is used to display remote-point status or alarm condition, and to display changes initiated via the keyboard before they are executed. In addition the CRT display provides the following displays on request:

- Single System
- Current Alarm
- Alarm Summary
- Status Summary
- Totals Summary

COMPUTER CRT CONSOLE

LOGGING PRINTER

The logging printer operates on request from the operator's keyboard to output a variety of logs in hardcopy form. Each separate log starts on a new page with the page number printed first, then the log title, time, and date. This is followed by a printout of up to date information provided by the H316. Printout is in black except for points with uncleared alarms. These points print in red. The following logs may be requested.

- Alarm Summary
- Status Summary
- Single System
- All Point
- Totals
- Trend
- Start-Stop Program Summary Time Information
- Start-Stop Program Summary Point Information

The logging printer is also used in the startup/backup mode to print new alarms, return to normals, and standard DELTA logs. In addition, the logging printer serves as standby for the alarm and message printer when the latter is shut off for servicing. That is, the operator may switch message printouts from the alarm and message printer to the logging printer. When this is done, printout terminates on the alarm and message printer, and the logging printer then serves to print both the above listed logs–on operator demand–and the automatic messages listed below.

ALARM AND MESSAGE PRINTER

Any change in the system causes automatic printout of a message on occurrence on the alarm and message printer. Each message is printed on an individual line and starts at one of three positions across the page, depending on the reason for the change. All printout is in black except new alarm messages. These print in red. The following types of messages printout automatically:

- Alarm change messages
  - New analog or digital alarms
  - Return to normals
- Status change messages
  - Command changes by operator
  - Changes by start-stop program
- Operator change messages
  - Assign/delete system or point
  - Enter new analog alarm limit data
  - Enter new start-stop program data
  - Operator sign on or off
  - Other computer access data

SYSTEM GRAPHICS PROJECTION MODULE

A system graphics projection module is furnished to provide rear-projection of slides relating to schematics of operating systems. The module automatically projects the proper schematic when a single system display is requested in the CRT. The projector may be left on while operating points within the selected system. The projector is also indexed to the proper system graphic on occurrence of a remote alarm.

The projector is operative both during the comptuer mode of operation and during startup/backup operation.

TRANSMISSION SYSTEM

A two-wire, coaxial, data cable is the transmission media used to carry all the scan and command messages between the central processing unit and remote data gathering panels.

Scanning is done continuously on the coaxial cable at 50,000 bits per second to detect alarms and keep the H316 data file up to date for all connected points. Operating in a half duplex manner, the central processing unit requests data from the first mechanical system and then listens while the data-gathering panel addressed sends data back for each point. When the last point is back, the central processing unit transfers all data to the H316 for processing and then requests data from the second system. This repeats until all systems are interrogated and then starts over. Operator commands to remote points interrupt at scan speeds only long enough to transmit the command. All data is double transmitted and compared for accuracy.

Where intercom stations are installed, a separate, two-wire cable is used. This is run in the same trunk with the coaxial data cable.

DATA GATHERING PANELS

The remote data gathering panels contain a mulitplexor and transmission equipment to service a remote mechanical system, or several systems, depending on the configuration. The panels serve as a collection point for analog and digital data for all connected points and normally contain some local loop control equipment for commands to local loops, such as control point adjustment, damper position adjustment, or start-stop modules. When several systems are being served from the same data gathering panel, the control equipment may be located in unit panels near the systems served.

ANALOG AND DIGITAL SENSORS

All information fed into a data-gathering panel is provided by a complete line of standard analog and digital sensors. Analog sensors include devices for dry bulb temperature, dewpoint, relative humidity, pressure, electrical units, or any other measurement with an input compatible to the central processor unit. These inputs can be used as inputs to the H316 real-time central computer to perform arithmetic operations and to provide calculated results such as flow, Btu's, efficiency ratios, costs, plant totals, and a variety of other useful data.

Digital sensors include contact devices to indicate status and/or alarm conditions for individual equipment. These are in the form of flow switches, starter contacts, pressure switches, filter runout devices, alarm devices, and other inputs compatible to the central processor unit. These inputs can also be used by the H316 real-time central computer to provide English printout of maintenance messages, alarm messages, and other useful data.

LEASED LINE INTERFACE UNITS

Buildings at a distant location, or where there is no convenient right of way for the coaxial data cable, may be served by a leased line interface system.

When analog and digital data is transmitted, ordinary 1200-baud, voice-grade phone lines are used. Connections may be two-wire or four-wire depending on the phone company service. For this application W935A/W935B leased line interface units are used at the central location and 1200-baud data-gathering panels at the remote.

The intercom function is not normally furnished for remote, leased-line locations. Instead central exchange telephone service is most often used.

EXECUTIVE PROGRAM AND APPLICATION PACKAGES

- *Executive Program* – The executive program is the basic program contained in all DELTA 2000 Computer Systems. This program includes the interrupts, priorities, and basic routines to accomplish data acquisition, outputs, and other periodic functions performed by the computer. The executive program includes:

  - Console keyboard inputs
  - Console CRT formats and display
  - Printer format and control
  - Interface control, H316 to CPU
  - H316 data file
  - Logging and scanning routines
  - Analog limits comparison
  - Priority system for operation of modular application packages

- *Application Packages* – Application packages are a combination of required hardware, including remote inputs and outputs, plus programming of the computer memory to produce the specified results. The application packages vary depending on the items furnished for a particular job. Application packages consist of:

  - Specifications
  - Macro flow charts
  - Operating sequence description
  - Input-output summary
  - Dedicated segment of H316 memory
  - Input sensors
  - Output devices
  - Hardcopy and CRT displays
  - Acceptance procedures

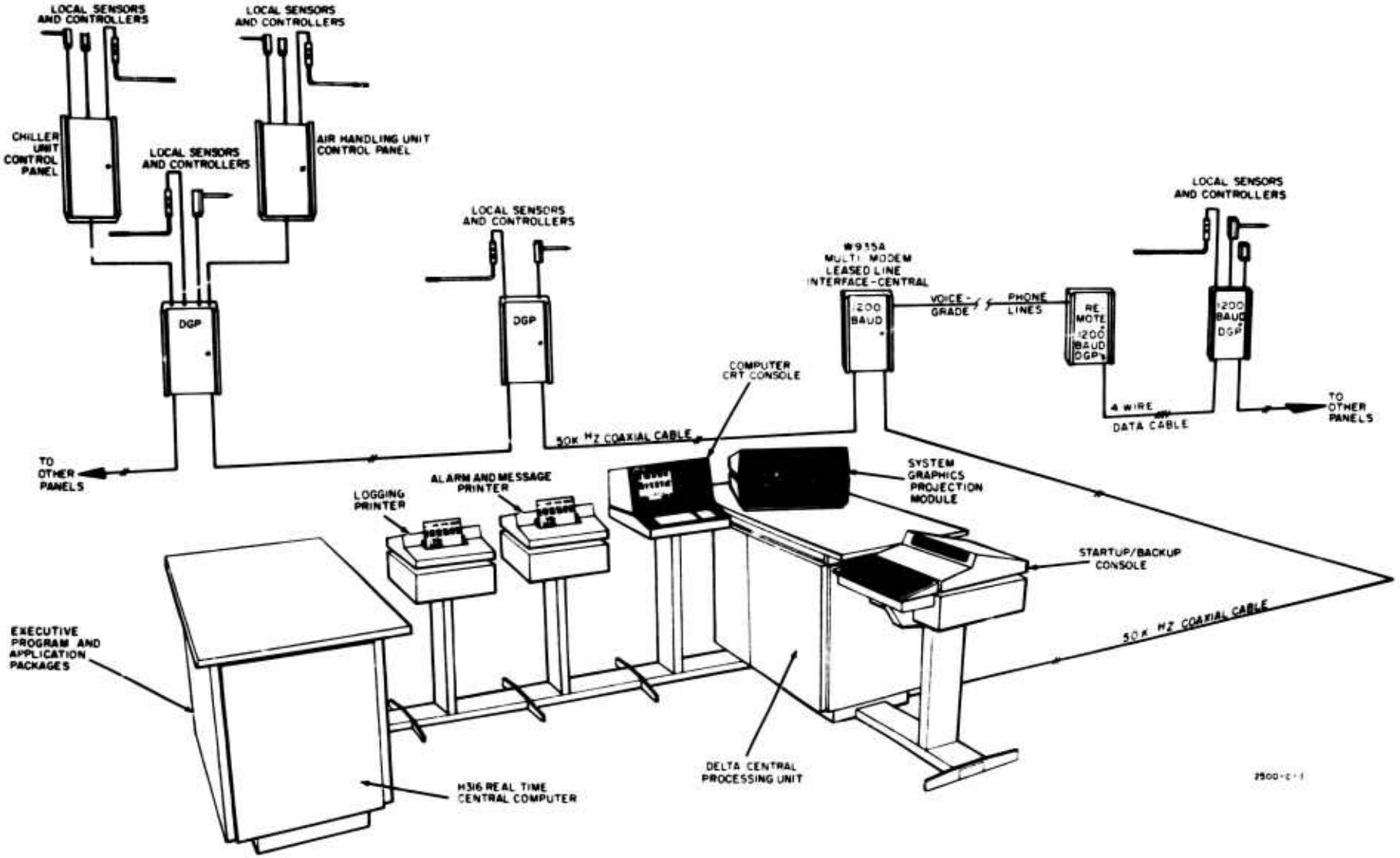
  Typical application packages are:

  - Trend logs
  - System energy profiles
  - Calculation program
  - Automatic start-stop program

SUPPORT SOFTWARE

Support software includes programs used by Honeywell factory and field personnel to program the H316. Support programs consist of:

- Program tapes
- Program listings
- DAP-16 assembler
- DEBUG (permits on-line program changes via the CRT keyboard)
- Patch loader (permits blocks of program changes via punched paper tape)
- 016-XREF Concordance generator
- H316/CPU interface checkout program
- CRT/printer interface checkout program
- Data file generator



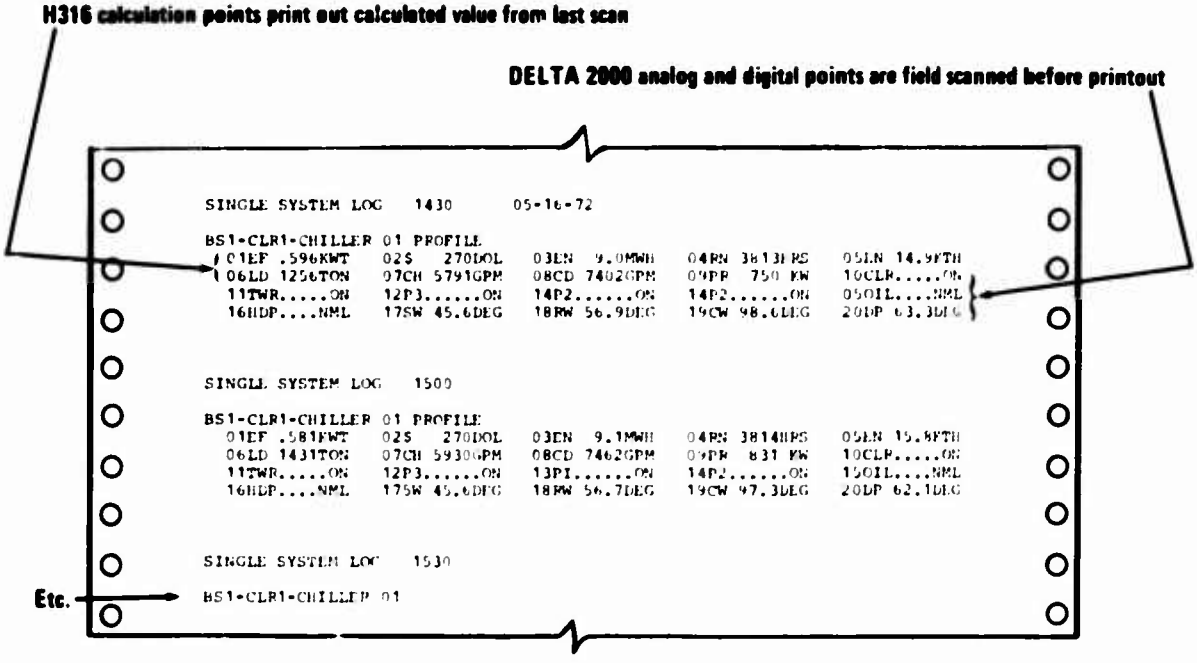
DELTA 2000 COMPUTER CONTROL SYSTEM
–SYSTEM COMPONENTS–

SYSTEM PERFORMANCE

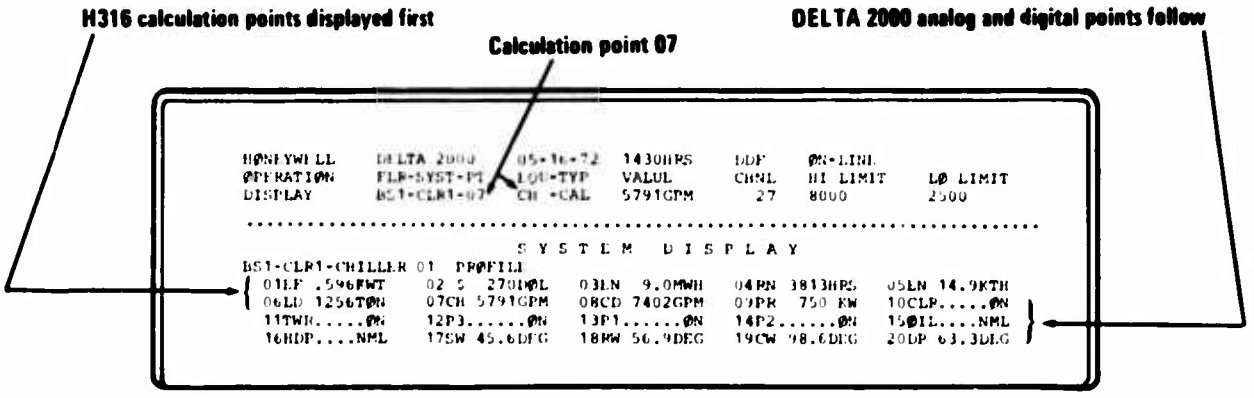
The DELTA 2000 Computer System performance is based on the ability of the central processor unit, transmission system, and remote data-gathering panels to rapidly gather information from field inputs. The H316 digital computer processes this data, and then the executive and application packages create English and mnemonic outputs via the CRT display and printers. The application package also permit digital commands, manual or automatic, to remote output devices, such as start-stop and CPA/DPA modules, via the central processor unit.

The following sections describe in detail how the operating software performs for the benefit of the console operator as well as for building management. The DELTA 2000 Computer System performance includes:

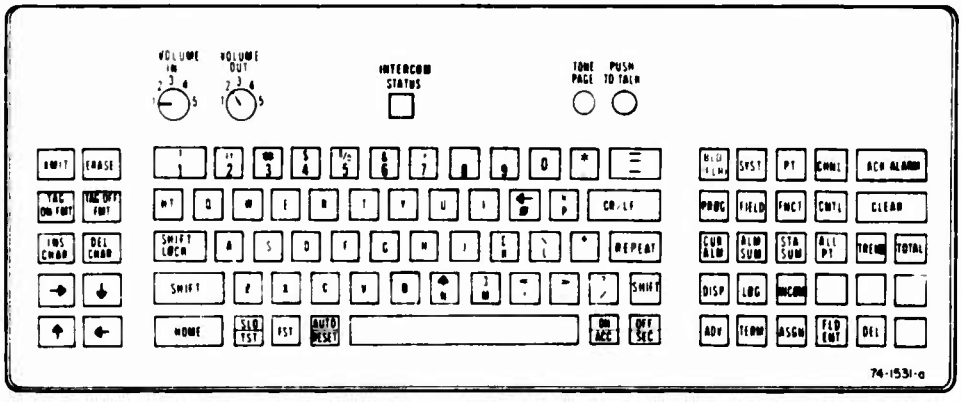
- Man-Machine Interface Functions
- Automatic Alarm Scan and Recording Functions
- Energy and Cost Control Program Functions
- Property and Life Protection
- Optimum Performance, On-Line Program Functions
- Management Information Functions
- Startup/Backup Operation Functions



SINGLE CHILLER SYSTEM LOG PRINTOUT



SINGLE CHILLER SYSTEM CRT DISPLAY



COMPUTER CRT CONSOLE KEYBOARD

E INTERFACE SHOWING TYPICAL SYSTEM DATA AVAILABLE TO OPERATOR VIA CONSOLE KEYBO

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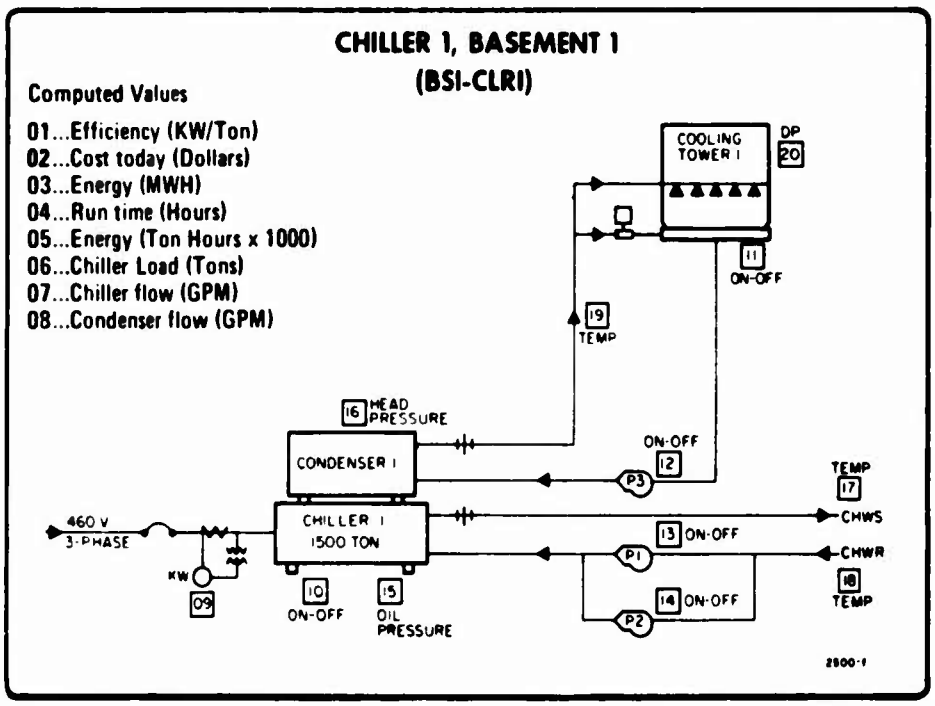


SINGLE CHILLER SYSTEM GRAPHIC DISPLAY

NSOLE KEYBOARD REQUEST

57<

MAN-MACHINE INTERFACE

Man-Machine Interface (MMI) is a term used to describe the command and display components used by the console operator. These components are:

- Computer/CRT Console
- Alarm and Logging Printers
- Selectographic Projector

The prime function of these components is to present remote system information to the operator quickly, and without need for interpretation, and to permit him to send commands to the remote systems that can be verified before being executed.

With the H316 real-time central computer on line, all man-machine interface is accomplished through the computer CRT console. Typically, single system displays may be obtained furnishing a projected graphic and updated CRT display of current values, a timed-interval log printout, and audio monitoring of the run condition of operating equipment. Individual analog and digital points may be displayed and control functions performed to change the run status of operating equipment or setpoint of local control loops. If personnel are in the remote mechanical equipment room, the voice intercom may also be used. If study or diagnostics is required of specific random points within the system or between systems–say a chiller plant and cooling towers–a trend log may be set up to record individual points over a period of time. Or, an all point log may be requested on a timed interval basis to study data from several systems rather than individual points.

While a large variety of functions can be initiated via the CRT Console, the following are the more frequently used by the operator:

- Computer/CRT Console Access
- Alarm Reports and Displays
- System Displays
- Single Point Displays
- On-Off Commands
- Control Point Adjust (CPA)
- Intercom with Remote Panels
- Log Printouts including Trend

All MMI software is designed so that memory locations are protected from operator errors. Any invalid command results in INVALID appearing blinking on the CRT. In addition hardware failures report as trouble (TBL) if a remote system fails to report to the CPU properly; error (ERR) is a remote point fails to report properly; or data transmission (DXM) if the software detects a hardware failure. Thus the operator is protected from performing invalid operations and from faulty data.

COMPUTER CRT CONSOLE ACCESS

Consistent with the sophistication of the DELTA 2000 Computer System, a four level console access is provided to assure that only authorized persons may perform specific functions. To obtain access the person operating the system must enter a four-digit identification number and his initials via the keyboard to operate the system. This number causes his initials to appear on the CRT display and permits one of the following levels of access:

Level 1 Guard level. Persons at this level may:
Acknowledge alarms only.
All manual control, display, and printout request keys are locked out.
Automatically generated display and printouts are not affected, however.

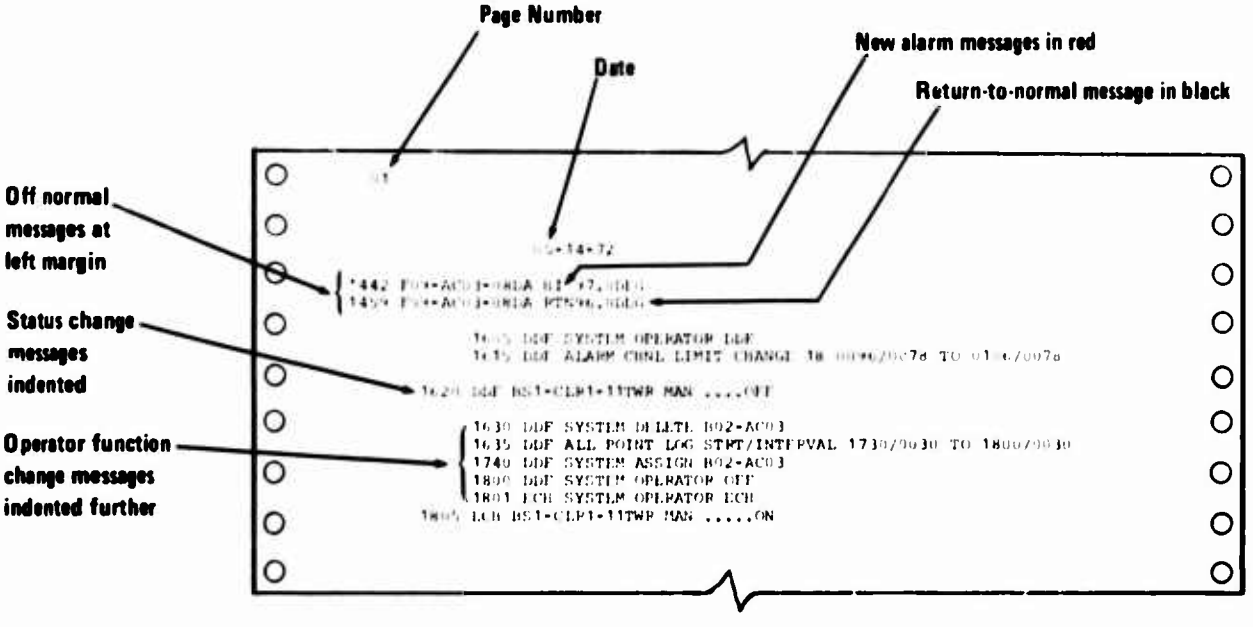
Level 2 Operator's level. Persons at this level may:
- Acknowledge alarms.
- Operate manual control keys.
- Operate display request keys.
- Operate log request keys.

Level 3 Supervisor's level. Persons at this level may:
- Acknowledge alarms.
- Operate manual control keys.
- Operate display request keys.
- Operate log request keys.
- Change parameters, such as, alarm limits start-stop program times, assign/delete of system and points.
- Change operator identification numbers, level, and initials.

Level 4 Programmer's level. Persons at this level may:
- Perform Level 3 functions.
- Change the internal computer program.

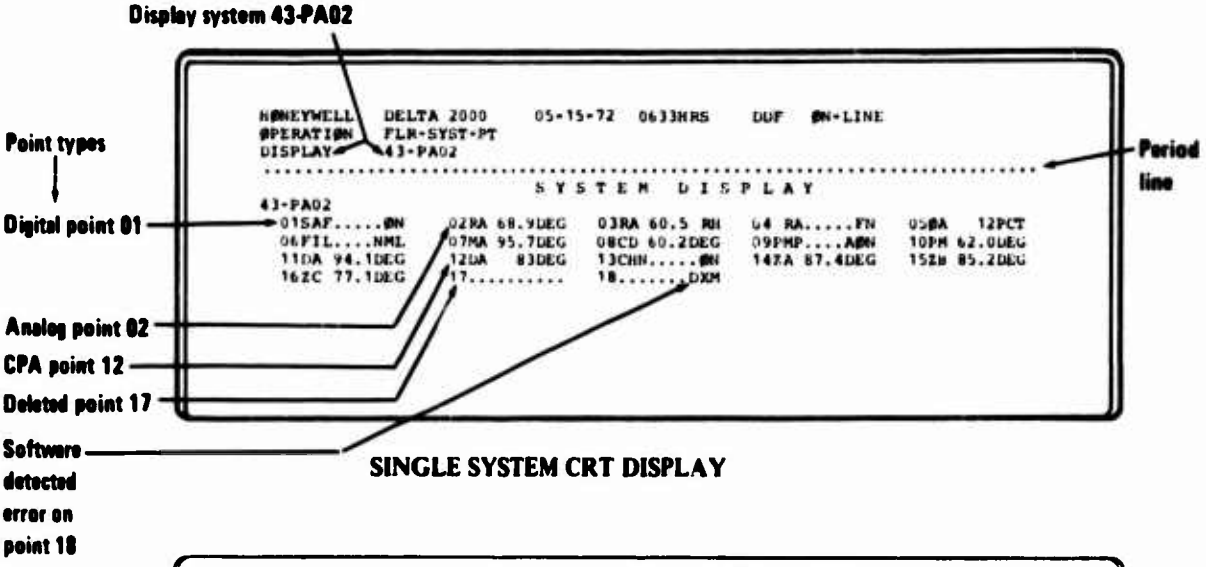
PRINTOUT OF SYSTEM CHANGES

Along with providing display, logging, and control functions, the system is designed to automatically furnish printed messages for all changes that occur whether from off-normal alarms or return to normals (RTN), remote status changes, or operator function changes. Off-normal messages print at the left margin. New alarms are printed in red and return to normals in black. Status-change messages are indented and indicate remote status changes caused by the system operator (MAN), by a start-stop program (AUTO), or by an optimized program (OPT). Operator function changes are indented further and indicate operator-permitted changes in the computer program parameters. These changes include items such as operator sign-in/off, analog alarm channel high/low alarm limit assignments system-point delete/assign, all-point log start and interval times, and other items necessary for man-machine interface. Thus, a printout is provided of all changes that occur in the system operation.

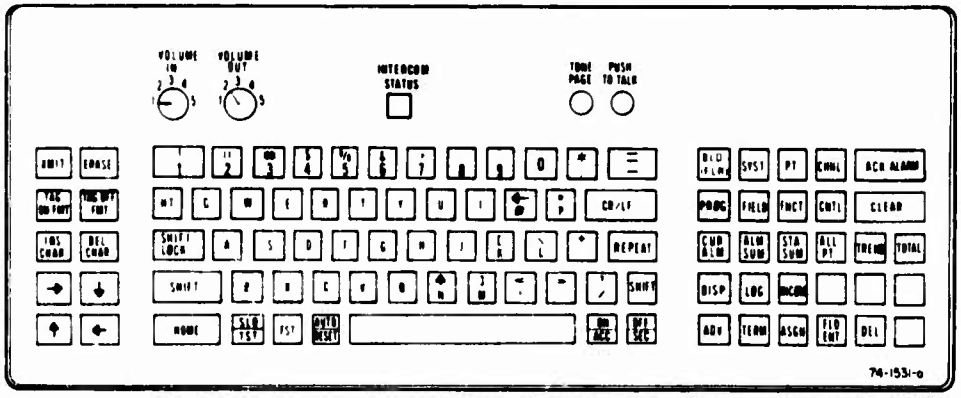


SYSTEM CHANGE MESSAGES

SINGLE SYSTEM DISPLAYS AND LOG



SINGLE SYSTEM CRT DISPLAY



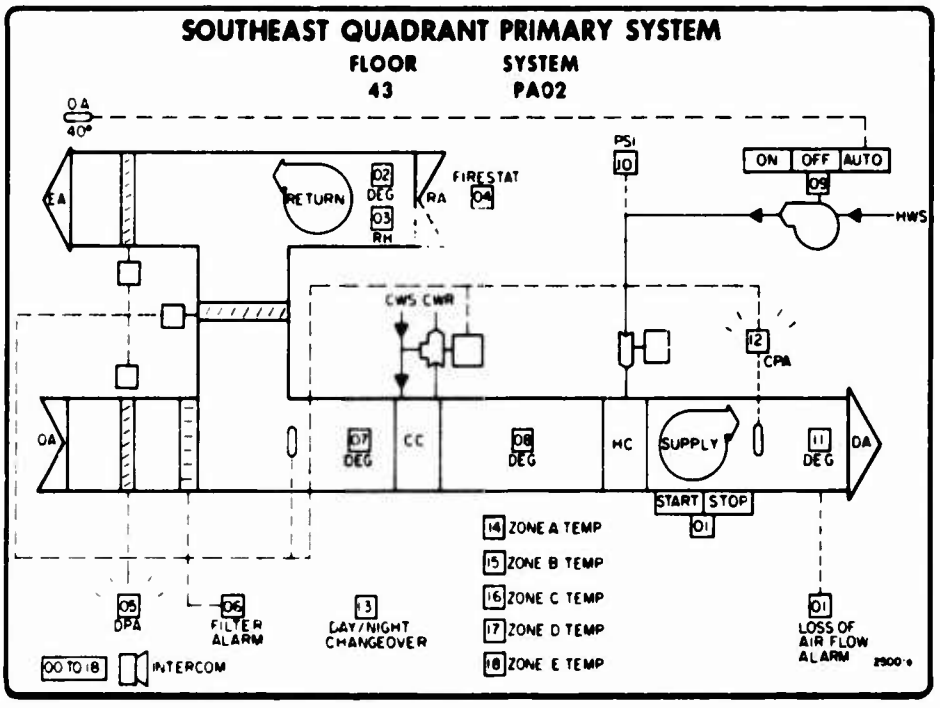
COMPUTER CRT CONSOLE KEYBOARD

The single system display is used to obtain information on the present status of any system selectable on the operator's keyboard. Up to date data is presented on the CRT display along with the related system graphic in the graphics projection module. Simultaneously, the voice intercom may be used to audibly monitor the run condition of operating equipment. Also, a printed record of the data display on the CRT may be obtained. The single system log occurs only on a timed interval basis.

1. SINGLE SYSTEM DISPLAY ON CRT WITH SYSTEM GRAPHIC AND AUDIO MONITOR

To request a single system display, the operator uses the keyboard to request FLR(or BLDG)-43-SYST-PA02. This information appears instantly on lines 2 and 3 to verify the system requested. Then the DISP key is pressed. Full system information is then displayed across the CRT including the action requested (DISPLAY), display title (SYSTEM DISPLAY), and complete analog and digital data for the system selected. For analog points in alarm, the engineering units will blink. For digital points in alarm, the status will blink.

The display also includes the present date, time, operator's initials, and point numbers for any previous operator action. A cursor, or small underline mark advances with all data displayed to assist in operating the display. The cursor returns automatically to Position 1 under period line after each operation.



SINGLE SYSTEM GRAPHIC DISPLAY

Pressing the DISP key also causes automatic selection of the related system graphic in the graphic projection module. Pressing the ADV key advances both the CRT and the graphics projector to the next consecutive system without entering a new address.

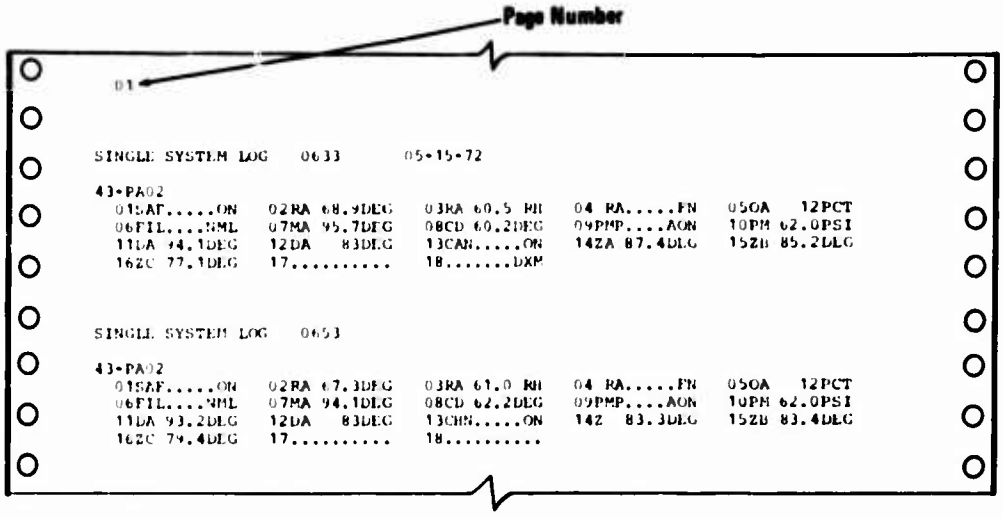
If the operator wishes to audibly monitor operating equipment while observing the CRT and system graphics, he simply presses the INCOM and ASGN keys to pick the related intercom.

A system may be deleted from or returned to the scan with hardcopy of such a change on the alarm and message printer. This might be done, with the DEL and ASGN keys, while remote equipment is being serviced, for example. While deleted, no alarms may occur, commands given, or CRT display provided for any points within the system. Only the graphics projection module will operate.

The keyboard may also be used for other housekeeping functions, with hardcopy on the alarm and message printer, such as entering the correct time or date.

2. SINGLE SYSTEM TIMED INTERVAL LOG

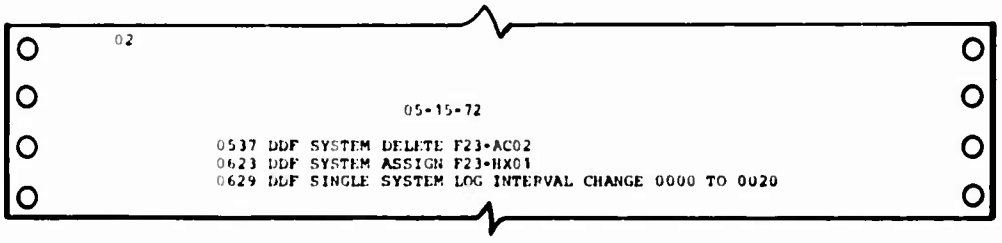
A single system may be logged on a timed interval basis simply by entering the desired interval time on the CRT keyboard, assigning the required system, and demanding the log. For example, an interval of 0020 (20 minutes) might be entered, system 43-PA02 assigned and the SYSTEM and LOG buttons pressed to initiate the log. Hardcopy for the new interval time is printed out, and a single system log printout occurs. All data is printed in black except for analog or digital-points with uncleared alarms. These points print in red. This log repeats at each timed interval until time 0000 is entered to stop the log. The terminate (TERM) button may be used to terminate any particular printout in progress, but will not terminate subsequent timed interval printouts. If the system is deleted from the scan, none of the system data will printout. Only the log heading will print.



First printout at time log is started

Subsequent printout at timed intervals

SINGLE SYSTEM LOG PRINTOUT



SINGLE SYSTEM MESSAGE PRINTOUT

3. ALPHANUMERIC ADDRESSING SOFTWARE

An alphanumeric addressing scheme is used to provide instant recognition of every building, floor, system, and point without relying on operator recall, directories, or other references. Three separate levels of identification are provided, and flexibility of the software permits a great variety of mnemonic codes to be used at each level. The following examples show a few of the possibilities:

Example: F12-AC03-15FAN---ON
Meaning: Floor 12, Air Conditioning Unit No. 3, point 15 is the address of a FAN that is "on"

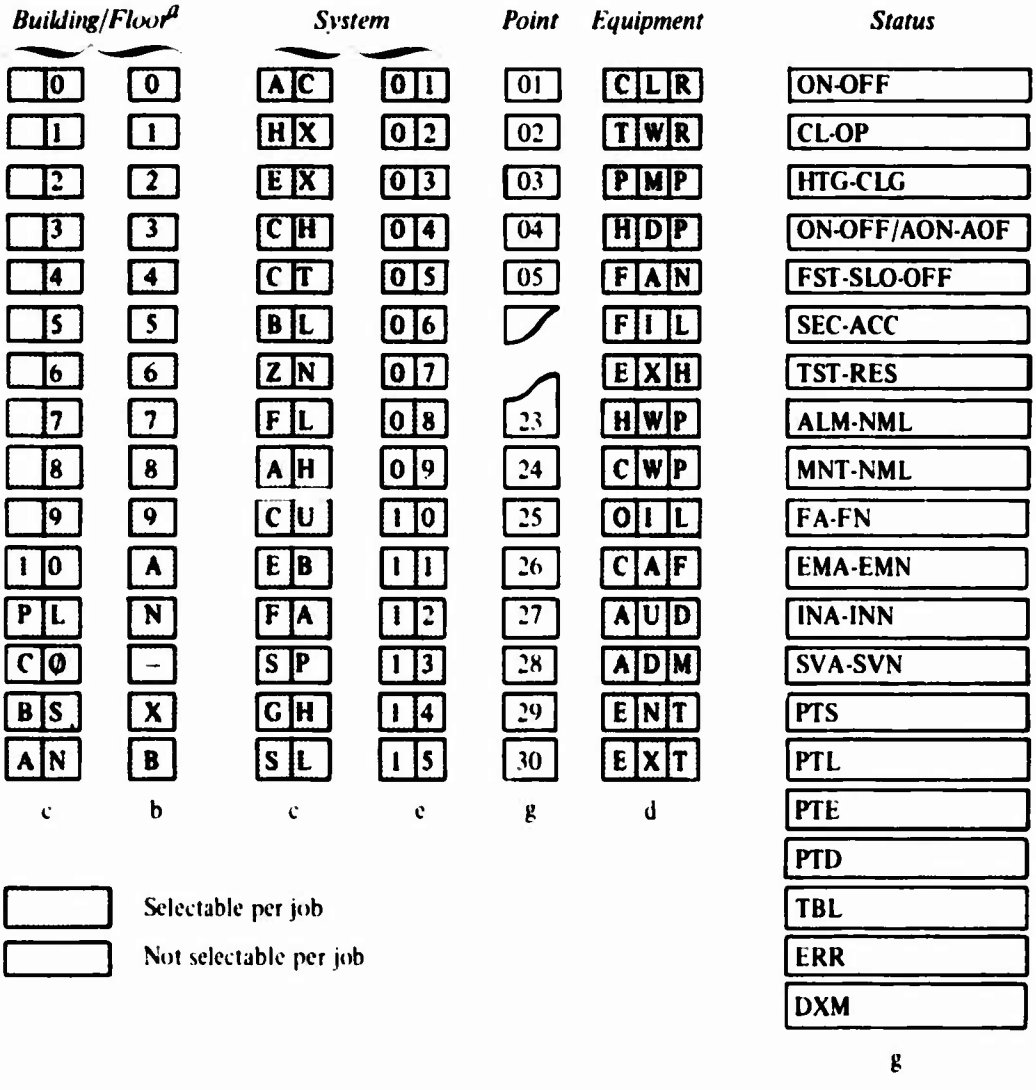
Example: 301-HX04-02PMP---OFF
Meaning: Building 301, heat exchanger No. 4, point 2, is the address of a pump that is "off"

Example: B02-CH02--01CMP---ON
B02-CH02---02LT 46.7DEG
Meaning: Basement 2, Chiller No. 2 Compressor is on and leaving temperature of the water at 46.7F

See alphanumeric code reference section following for other address and display mnemonics available.

4. ALPHANUMERIC CODES FOR DIGITAL ADDRESS IDENTITY

The following illustrates typical alphanumeric codes for digital address identity (see related Notes a to g on page 22):



Based on the typical alphanumeric coding shown above, the following are examples of digital address *combinations permitted*:

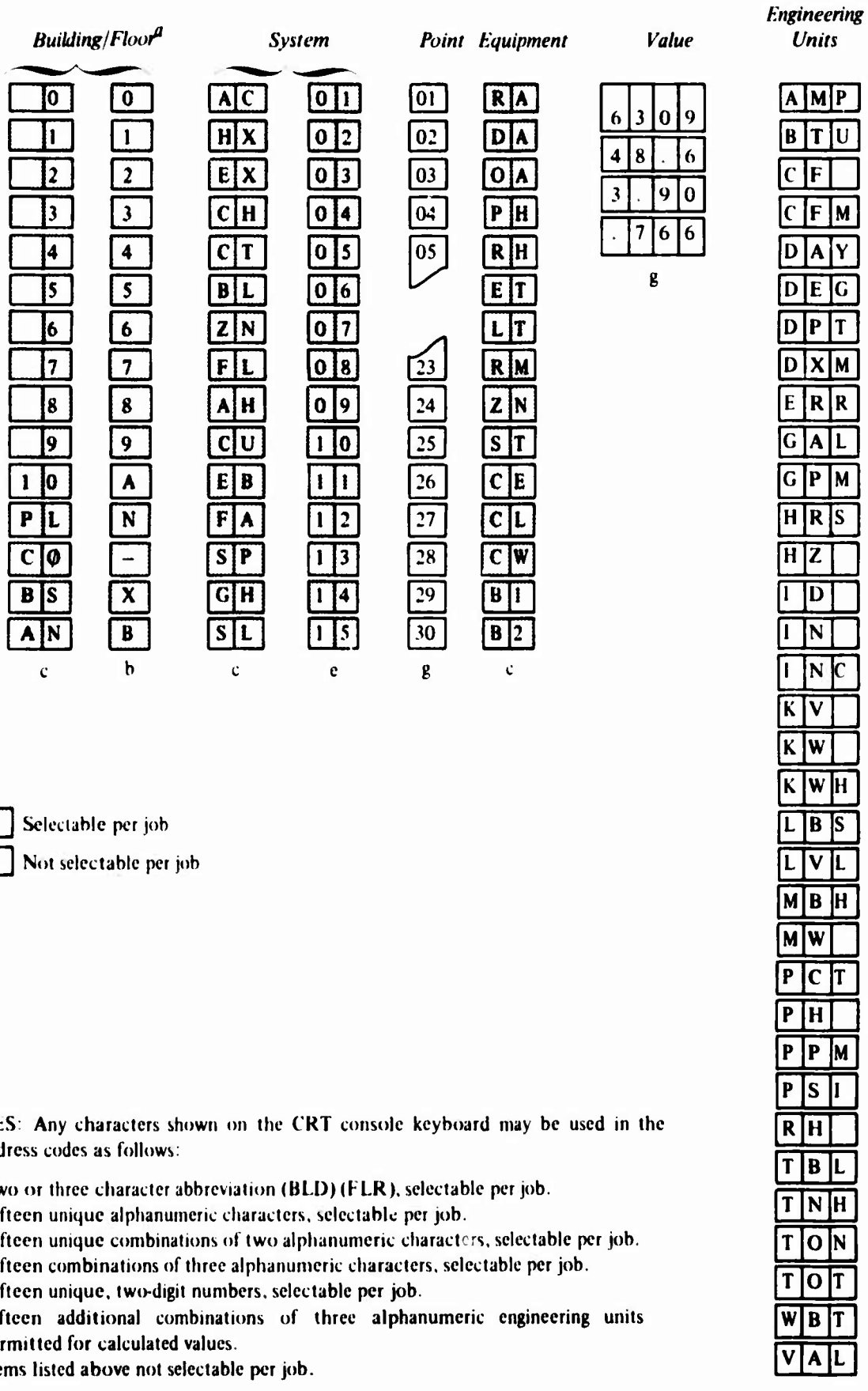
Building/Floor	*System*	*Point*	*Equipment*	*Status*
11	HX14			
24	BL01			
197	AH01	No restrictions		
BS7	AH13			
PL3	ZN02			
ANX	ZN03			

The following combinations *are not permitted*, based on the typical coding above:

Building/Floor	*System*	*Point*	*Equipment*	*Status*
186	07			
AN	AC16			

5. ALPHANUMERIC CODES FOR ANALOG ADDRESS IDENTITY

The following illustrates typical alphanumeric codes for analog address identity (see related Notes a to g below):



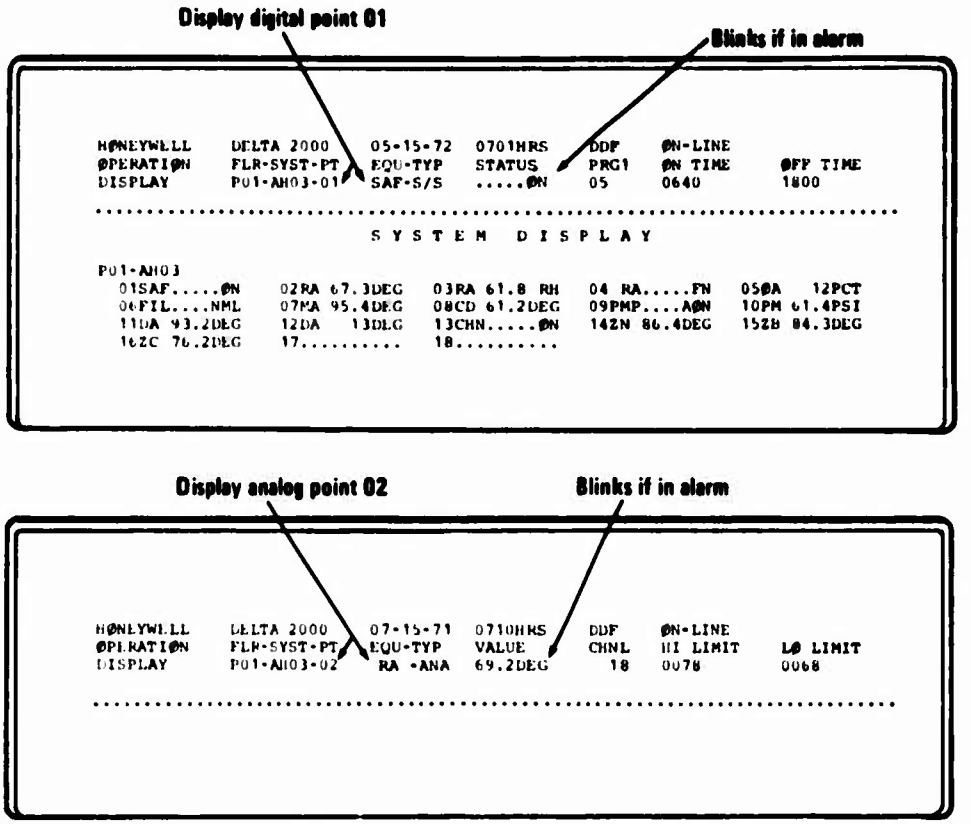
Selectable per job

Not selectable per job

NOTES: Any characters shown on the CRT console keyboard may be used in the address codes as follows:

a. Two or three character abbreviation (BLD) (FLR), selectable per job.
b. Fifteen unique alphanumeric characters, selectable per job.
c. Fifteen unique combinations of two alphanumeric characters, selectable per job.
d. Fifteen combinations of three alphanumeric characters, selectable per job.
e. Fifteen unique, two-digit numbers, selectable per job.
f. Fifteen additional combinations of three alphanumeric engineering units permitted for calculated values.
g. Items listed above not selectable per job.

SINGLE POINT DISPLAY



DIGITAL AND ANALOG POINT CRT DISPLAY

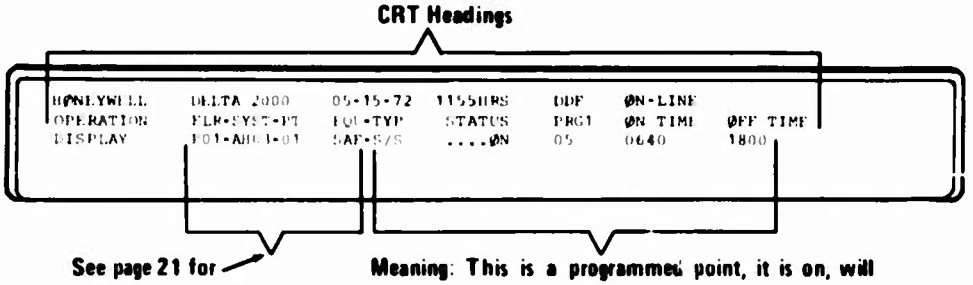
Single points may be addressed for purposes of displaying the digital status or analog value on the CRT. The related system graphic may also be selected while monitoring the single point, as well as the intercom to audibly monitor the run condition of mechanical equipment within the related system.

1. POINT DISPLAY OPERATION

A single point may be displayed by selecting the BLD/FLR, the system, the desired point, and then DISP, as shown. Pressing the PT and ADV keys will advance the CRT display to the next point (02) in the system as shown in the same figure.

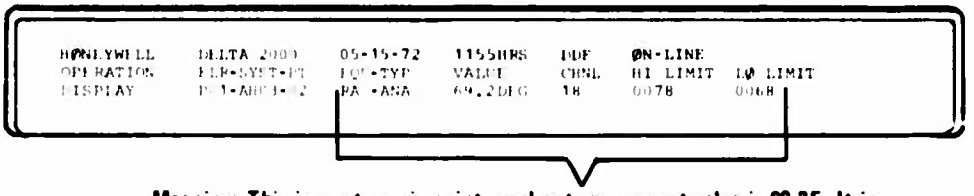
2. POINT DISPLAY OF STATUS, VALUE, AND MEMORY CONTENT

For each digital point, the following is the type of information typically displayed on the CRT.

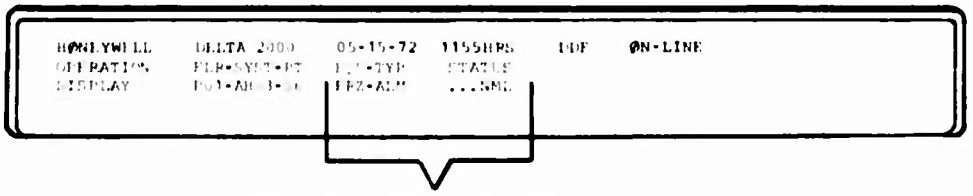


See page 21 for additional examples.

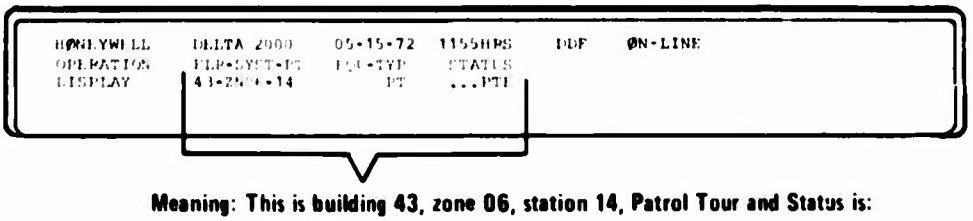
Meaning: This is a programmed point, it is on, will turn off at 1800 hours, and turn on again at 0640 hours.



Meaning: This is a return air point, analog type, current value is 69.2F. It is assigned to channel 18 which has high and low alarm settings of 78F and 68F.

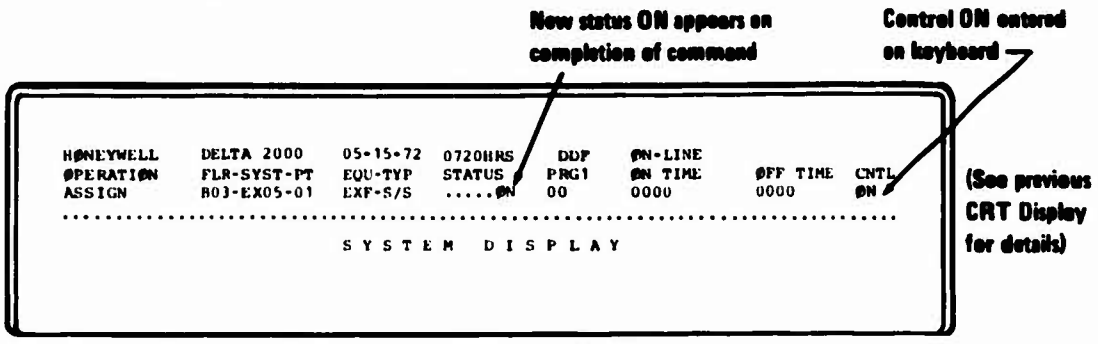


Meaning: This is a freeze-alarm contact, and is normal.

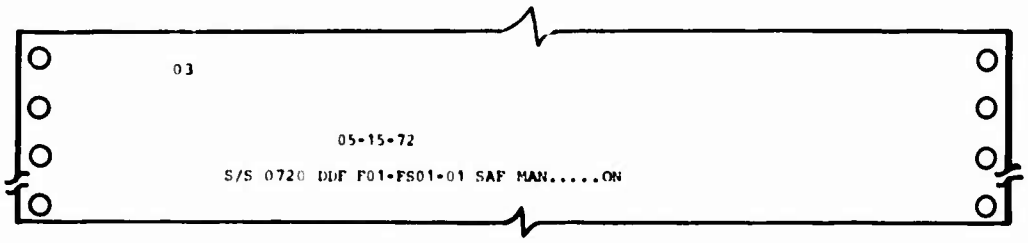


Meaning: This is building 43, zone 06, station 14, Patrol Tour and Status is: "Patrol Tour Ended".

ON-OFF COMMANDS



START-STOP CONTROL ON CRT DISPLAY



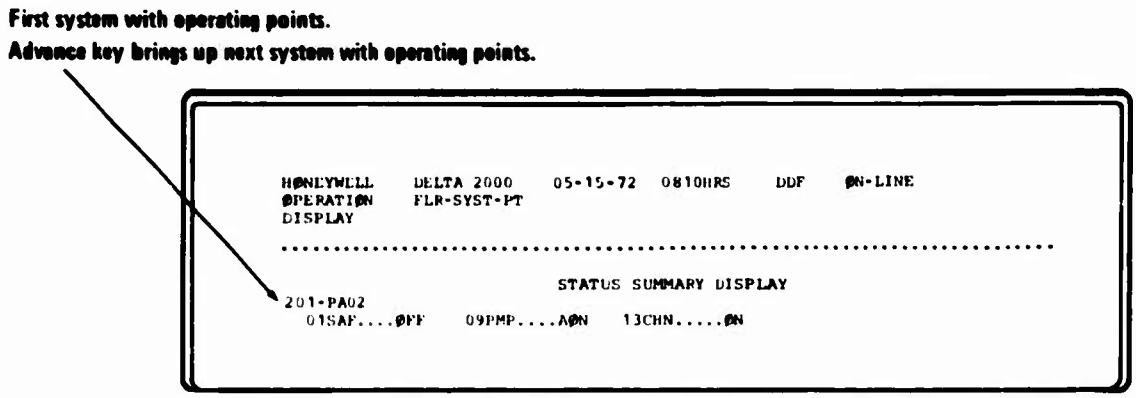
START-STOP MESSAGE PRINTOUT

The operator can address an on-off point, see its on or off status on the CRT, and command it to start or stop from the keyboard. The related system graphic may also be selected while operating the keyboard, as well as the intercom to audibly monitor the startup, shutdown, or run condition of selected equipment. Three position functions like ON-OFF-AUTO are also available to the console.

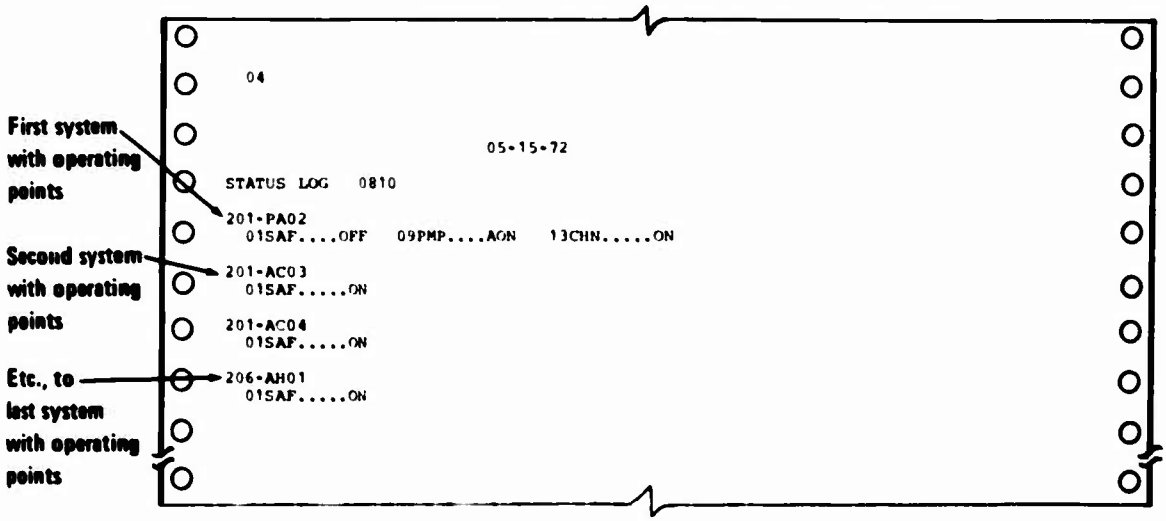
Operation–

Referring to the CRT display the operator selects a point, observes its status (OFF) and then pushes the CNTL, ØN, and ASGN keys. After the motor starts, the CRT status word changes to "on", and the printer records the change. If the motor fails to start, the alarm tone sounds and an alarm message prints in red. In addition, the word "off" on the CRT blinks to show an alarm condition.

STATUS SUMMARY DISPLAY AND LOG



STATUS SUMMARY CRT DISPLAY



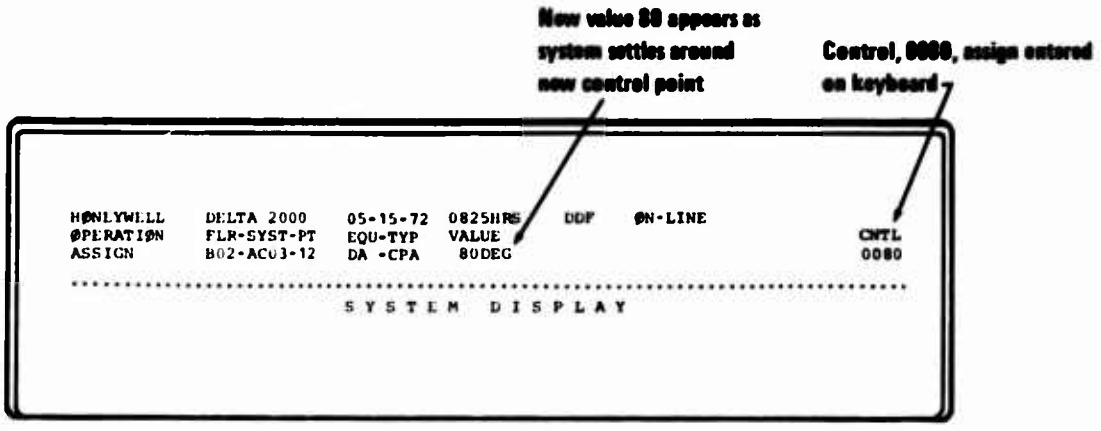
STATUS SUMMARY LOG PRINTOUT

A status summary may be obtained on the CRT display, or a log printout obtained, of the present status of all operating equipment furnished with a two or three-position control function or a pure status contact. Both the display and printout are obtained on demand through the CRT keyboard, and a typical example is shown.

Operation

The status display on the CRT shows one system at a time, with on or off (or other) status for each "start/stop" point. Points in alarm blink. Pressing the ADVANCE button will display all systems in order, as fast as the ADVANCE button is pushed. The printed report will automatically record status of all connected on-off points after a status summary log has been requested. All off normals print in red.

CONTROL POINT ADJUSTMENT



CONTROL POINT ADJUSTMENT CRT DISPLAY

The control point adjustment (CPA) function permits monitoring the present setting of a remote control point on the CRT and making adjustments via the keyboard. The CPA function is normally related to a temperature (or other analog) measurement point in a control system.

1. OPERATION

Referring to the CRT display, a single CPA point may be displayed indicating the present analog value of the control point. To change the control point, the operator types in CNTL and the new value desired via the keyboard. This value is displayed under CNTL on the CRT before entry into the computer and then entered by pressing ASGN. On entry, a command is issued providing a new CPA setting at the remote point. The CRT continues to display present analog value as the system settles around the new control point.

2. DAMPER POSITION ADJUSTMENT

The damper position adjustment (DPA) function is similar to the CPA except that point type DPA appears under TYP in the CRT display. Also, the settings are in 0 to 100 PCT open. This function may position a damper directly, or it may provide a minimum-position setting in a remote control system with a minimum percent outdoor-air ventilation requirement.

INTERCOMMUNICATION

Along with audio monitoring of remote operating equipment, the intercom system provides two-way voice communications between the operator's console and intercom stations located remotely throughout the building, or building complex. The system permits tone paging of remote personnel and call in from remote stations.

1. CONSOLE CALL TO REMOTE INTERCOM STATION

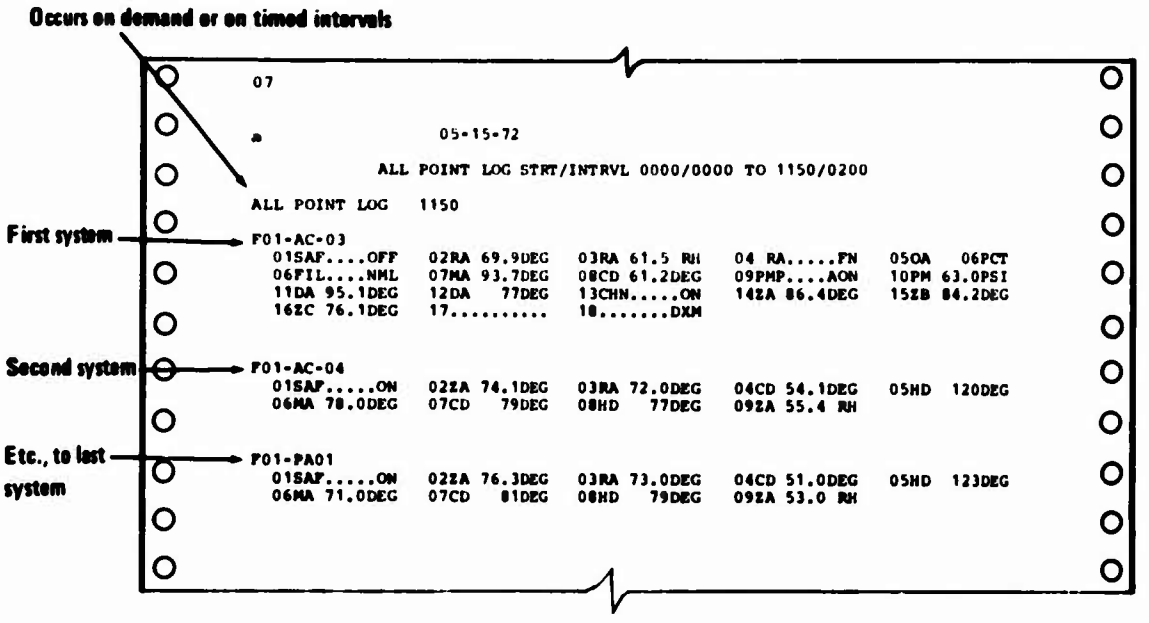
For this function, the console operator addresses the remote system containing the intercom station through the keyboard and then selects the intercom with the INCOM-ASGN keys. The intercom station requested then turns on. The operator then presses the TONE PAGE key and waits a moment for the remote person to answer. The direction of conversation is then controlled by the console operator with the PUSH TO TALK key and the volume with the VOL IN/VOL OUT controls.

If desired, the console operator may turn on up to twenty intercom stations at once for tone paging, or for addressing personnel at several locations by voice. For multistation requests, all stations turn off together when the INCOM-TERM (terminate) keys are pressed.

2. REMOTE INTERCOM STATION CALL TO CONSOLE

To call in, the remote person merely presses a CALL SWITCH button on the remote station and announces his station number and the desire to communicate. The console operator then addresses the remote system and selects the intercom. The direction of conversation is then controlled by the console operator in the normal manner.

ALL POINT LOG PRINTOUT



ALL POINT LOG PRINTOUT

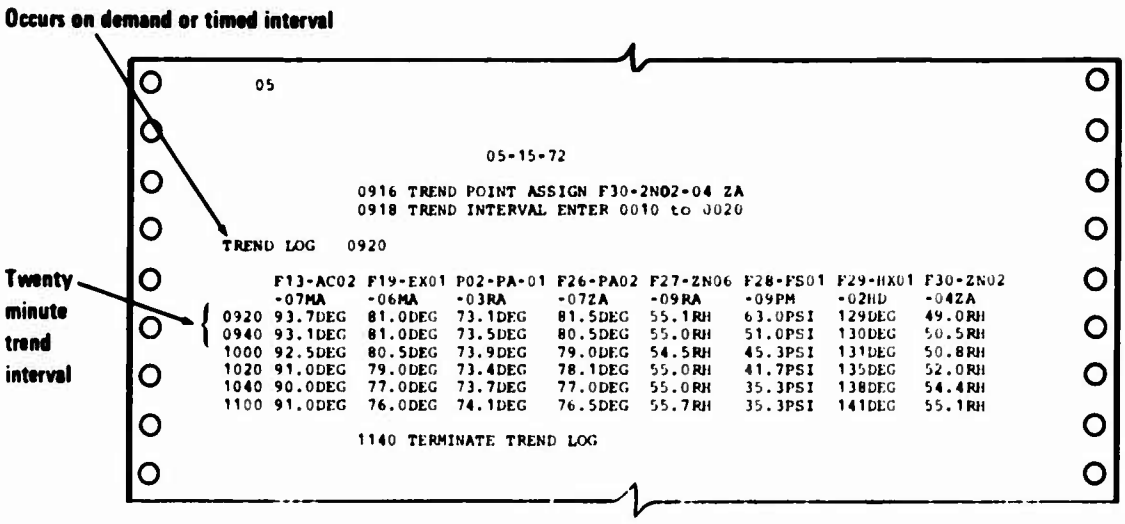
The all-point log is used to obtain a record on the logging printer of all points in the building by system in logging order. The all-point log may be obtained either on demand or on an interval basis with both the start time and the interval time determined by the operator.

Operation –

The operator can demand this log at any time or assign it to a fixed time interval.

All points (not deleted from the scan cycle) will be recorded.

TREND LOG PRINTOUT



TREND LOG PRINTOUT

The trend log is used to obtain a record on the logging printer of up to eight random points in the building on a timed interval basis. Printout is columnar with point identification printed out as each column heading and the value or status for each point printed out at timed intervals in the appropriate point column. A printout may also be obtained on demand.

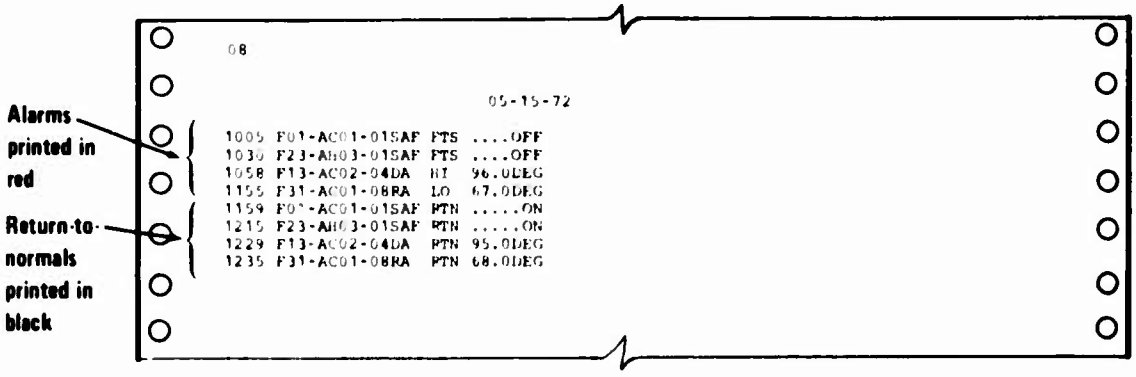
Via keyboard, the operator may assign or delete trend points, select a trend interval from 1 to 2400 minutes, and start or terminate the trend log. An example of a trend log is shown.

AUTOMATIC ALARM SCAN AND RECORDING

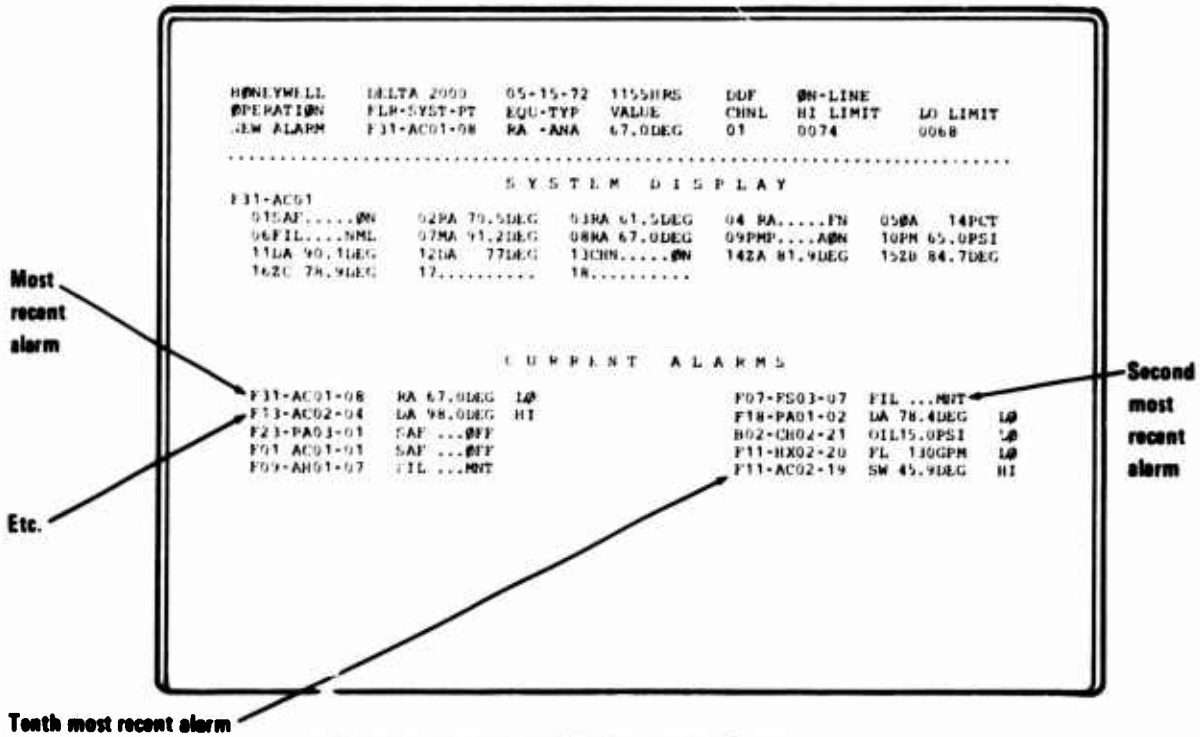
The automatic alarm scan and report function relies on the ability of the high-speed central processor unit to continuously scan each remote data-gathering panel and bring the latest analog and digital point information back to the H316 real-time central computer. The computer then processes data for each system and automatically prints any new alarms or return to normals. Digital alarm information is obtained from contact alarm devices on each scan cycle. Analog alarm information is obtained from analog pulse transmitters and compared with one of 55 high-low alarm limit channel settings stored in the H316 every 30 seconds.

Although scanning and printout is automatic, the operator may obtain additional data on any particular alarm rapidly by requesting system display, point display, or a current alarm report which displays the ten most recent uncleared alarms. Further, if an operator is interested in all current alarms, say at the beginning and completion of a daily shift, he may request an alarm summary display or log printout. These items are discussed below.

AUTOMATIC PRINTOUT AND ALARM-TONE ANNUNCIATION



NEW ALARM AND RETURN-TO-NORMAL MESSAGE PRINTOUT



CURRENT ALARM REPORT CRT DISPLAY

New alarms are printed on the alarm and message printer and sound an alarm tone. Printout is in red and provides the time, point number, equipment type (mnemonic) and the following:

For digital points

- Present status
- Reason for alarm
  - FTS–Failed to start (or stop) on command
  - LOC–Point went into alarm for some field reason

For analog points

- Present value and engineering unit
- Direction of new alarm
  - HI–Exceeding high limit setting
  - LO–Less than low limit setting

Return to normals also print automatically but produce no alarm tone sound. Printout is in black and provided with mnemonic RTN (return to normal).

OPERATOR RESPONSE TO NEW ALARMS

New alarms produce hardcopy printout and an alarm tone, but no automatic display on the CRT. On hearing the alarm tone, the operator may do any of the following to obtain additional data or perform operations on the new alarm point:

1. ACKNOWLEDGE ALARM

The automatic alarm printout provides hardcopy record of the most recent alarm. For example, at 1155 point F31-AC01-08 indicates RA67.0DEG LO by a red printout and alarm tone annunciation (return air 67 degrees too low). The operator may then read the printout and silence the tone by pressing the ACK (acknowledge)key.

2. REQUEST SINGLE SYSTEM DISPLAY

The operator may press the SYST-DISP keys just prior to acknowledging the new alarm. This will cause an immediate CRT display of the system containing the new alarm plus the related system graphic. For analog points in alarm, the engineering units will blink. For digital points in alarm, the status will blink.

3. REQUEST SINGLE POINT DISPLAY

In addition, the operator may press the PT-DISP keys prior to acknowledging the new alarm. This will cause an immediate CRT display of the new alarm point. While the alarm point is in the display the operator may perform any required action, such as initiating start-stop commands, entering new analog alarm limits, or assigning or deleting the point from alarm limit channel assignment.

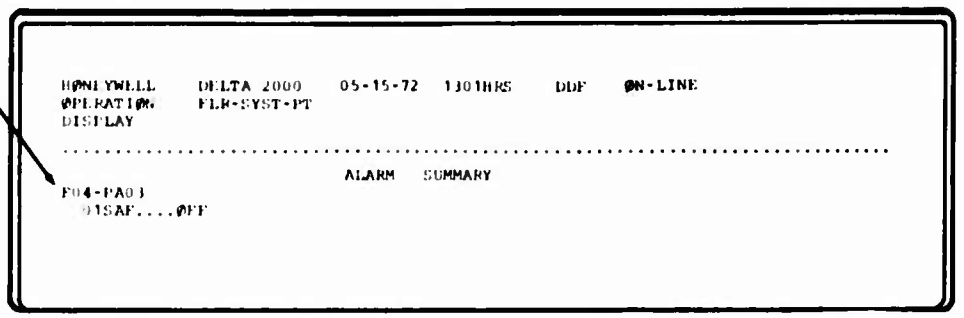
4. REQUEST CURRENT ALARM DISPLAY

Further, the operator may request a current alarm display at any time simply by pressing the CUR ALM and DISP keys. This causes a report of the ten most recent uncleared alarms to appear in the low part of the CRT display. The display is updated automatically as new alarms occur. If the current alarm report is currently being displayed when an alarm occurs, the new alarm will automatically be displayed at the top, upper left-hand corner of the current alarm display area. The current alarm report will remain until the operator presses the CLEAR button or requests a CRT display requiring the space occupied by the report.

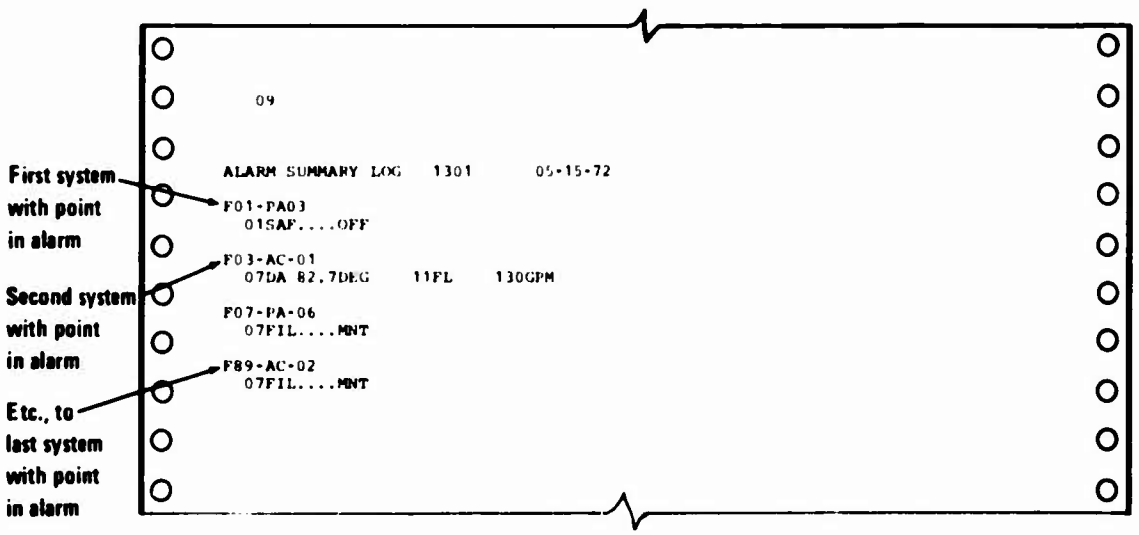
ALARM SUMMARY LOG AND DISPLAY

First system with uncleared alarms.

Advance key brings up next system with uncleared alarms.



ALARM SUMMARY CRT DISPLAY
AVAILABLE TO OPERATOR ON REQUEST VIA KEYBOARD



ALARM SUMMARY LOG PRINTOUT
AVAILABLE TO OPERATOR ON REQUEST VIA KEYBOARD

Alarm summary logs and displays may be used to obtain a display or hardcopy of all presently uncleared analog and digital alarms in the system. For the alarm summary display, only systems with points in alarm are displayed, nonblinking. The ADVANCE key brings up the next system with points in alarm as soon as it is pressed. For the alarm summary log printout always starts with the first system with points in alarm to the last, until the log is complete, or until the operator presses the terminate (TERM) key if the log printout is to be terminated early. Both the display and the printout are shown.

75<

PROGRAMMED ALARM LOCKOUT

In some instances it may be desirable to have alarm printout and annunciation inhibited for a selected point or points within a system when another point or points within the same system or other systems are normally turned off. This may be accomplished via the computer program to prevent nuisance alarms when systems are normally shut down. When this occurs, the alarm points affected are said to be locked out, and are called lockout points. Lockout points may be analog or digital.

The point or points that cause the lockout to occur by being normally turned off are called lockout origins. Each system may have up to three lockout origins. Lockout origins must be digital points.

If a system contains more than one lockout origin, they will be logically "ANDed" or "ORed" together by the program. That is, if ANDed, the lockout points will be locked out only if all the lockout origins are normally off, otherwise the lockout points will be unlocked.

When the one or more lockout origins are turned on normally, an amount of time is provided before lockout points are unlocked and can be subsequently alarmed. This is called unlock delay and is program controlled for either a 60 to 90 second delay or a 120 to 150 second delay.

Each addressable system (of up to 30 points) may have 1, 2 or 3 lockout origins as described above. When the lockout origin(s) is turned off, all alarm points within that system which have been assigned to lockout are inhibited from alarm reporting, and the system is said to be locked out.

ENERGY AND COST CONTROL PROGRAMS

Energy and cost control programs are derived from the ability of the H316 real-time central computer to perform calculations using system input analog and digital information plus manual inputs and constants and convert this into understandable terms, such as dollar per ton of cooling, efficiency (kilowatts per ton), energy (kilowatt hours), etc. By logging this data over a period of time, profiles can be established for energy and cost requirements for major operating equipment throughout a building for various load conditions that may vary with time of day, day of week, season, and occupancy factors, etc. These profiles may then be used by management, along with present CRT display and log outputs to evaluate performance of machinery compared with history.

For example, an operator may use an energy profile to determine the best operating configuration for several chillers for various load conditions; or an operator may use an electric demand profile to dump secondary electric loads as demand peaks are approached, or to reschedule programmed start-stop equipment to avoid those peaks.

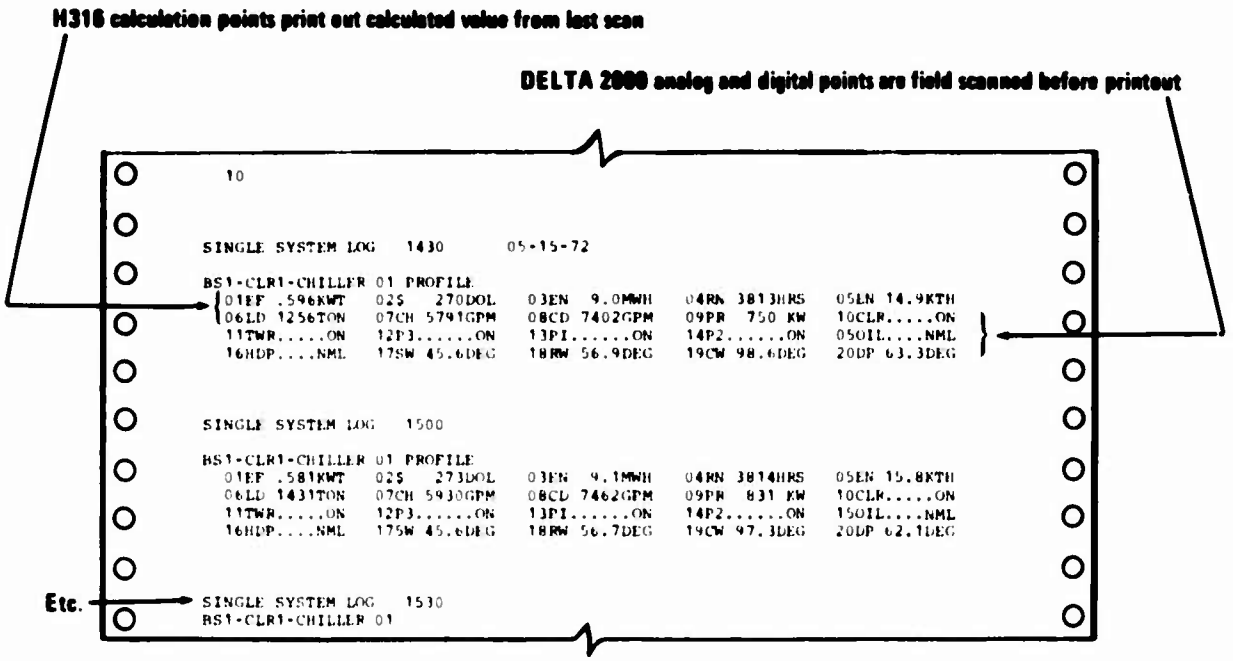
To assist in obtaining pertinent data, a totalizer log is provided which furnishes a printout only of systems containing totalized data. Printout is on a system basis. Typically, only those systems print which provide management with overall system-operation cost information, such as chiller-accumulated ton-hours (Btu), dollars this day, etc. The log may be obtained on operator demand and also prints out on a daily basis as the totals accumulated in the computer are automatically reset. The daily time of printout may be selected to best suit operating record requirements. If a total display on the CRT is preferred to a log, a totals summary may be obtained. In this case the CRT presents the first system containing totals (or other system on operator demand). The CRT is then manually advanced through systems containing only totals.

In addition to calculations, the computer also is furnished with fixed-time, start-stop programs which automatically schedule operation of mechanical and electrical loads at operator-selected times throughout a week. Heating, ventilating, and air conditioning systems may thereby be started early enough so a building may be comfortable when people come in. Lighting may also be turned on in time for occupancy. These programs assure that equipment is only operated at specified times.

Although the use of equipment profiles and fixed time start-stop programs are basically off-line, requiring operator attention to effect improved operation, much economic benefit can result from the ability to track cost and efficiency hour by hour and day by day. Some of the techniques most often used are:

- Single Chiller System Profiles
- Chiller Plant System Profiles
- Electric Energy Distribution Profiles
- H316 Calculation Forms
- Automatic Start-Stop Programs

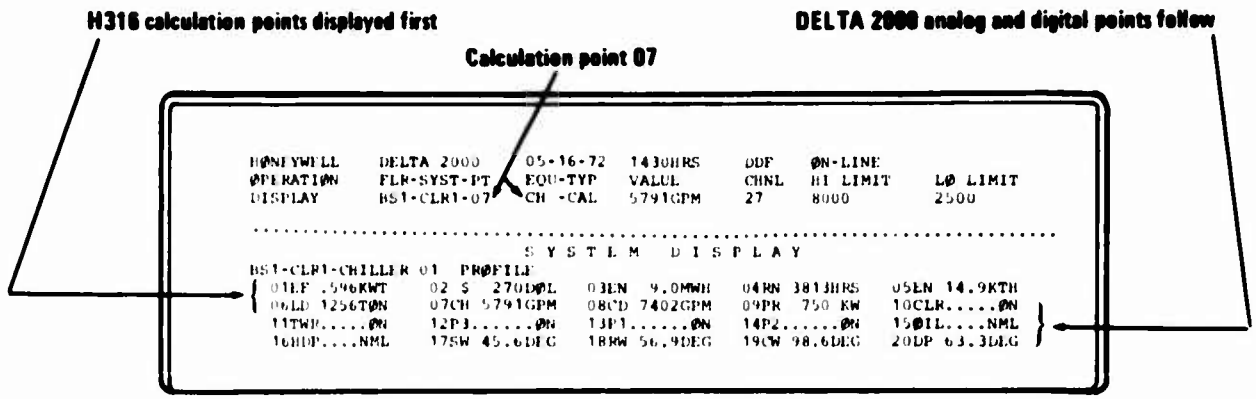
SINGLE CHILLER SYSTEM PROFILE



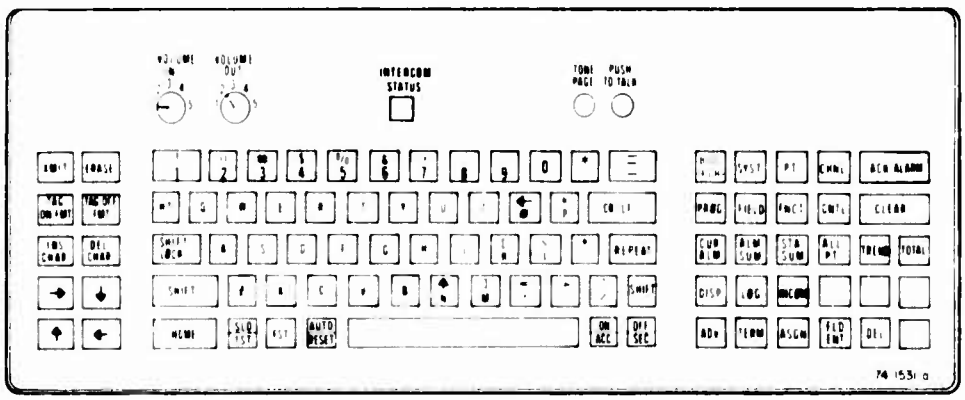
SINGLE CHILLER SYSTEM LOG PRINTOUT

A single chiller may be addressed on the console keyboard to obtain a projected graphic and a CRT display of energy and performance calculations and other field data. When a single calculation point is addressed (07 for example), the point type (TYP) indicates that the analog value (VALUE 5791 GPM) is an H316 computer calculation (CAL). Calculation points may be assigned to a high-low alarm limit channel the same as analog field inputs.

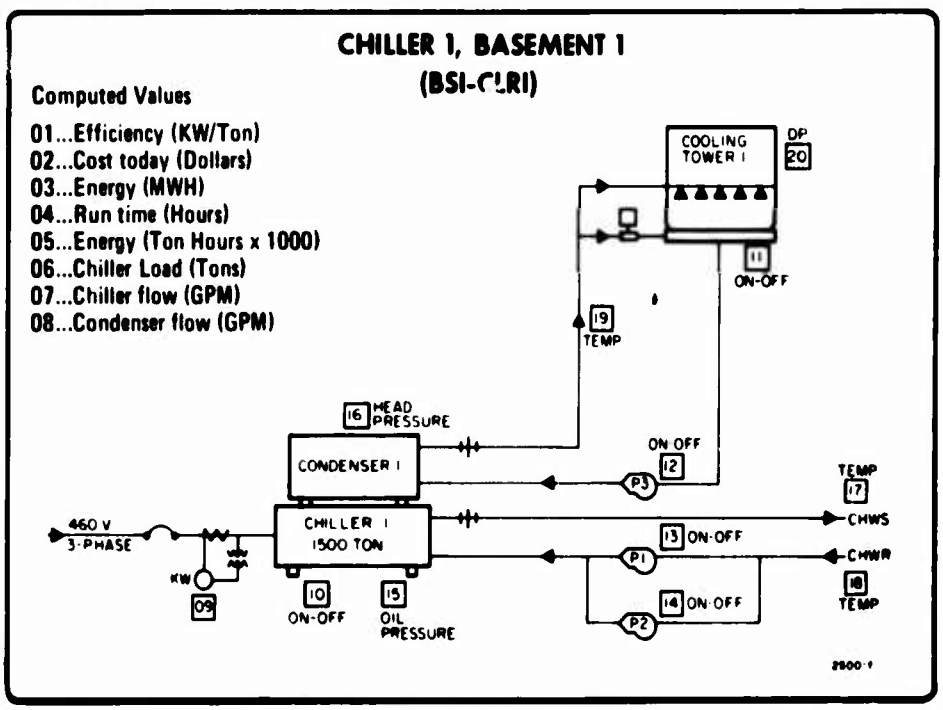
A timed interval log may be requested to prepare a profile of operating characteristics. Each log output prints energy and performance calculations from last scan and field points from present scan.



SINGLE CHILLER SYSTEM CRT DISPLAY



COMPUTER CRT CONSOLE KEYBOARD



SINGLE CHILLER SYSTEM GRAPHIC DISPLAY

CHILLER PLANT SYSTEM PROFILE

```
011

SINGLE SYSTEM LOG   1431      05-15-72

BS1-CLRP-CHILLER PLANT PROFILE
  01EF .845KWT   02$  1131DOL   03EN 26.2MWH   04EN 21.8KTH   05LD 3071TON
  06PR 2599 KW   07CH 11.9KGM   08CD 28.2KDM   09CW 99.6DEG   10SW 45.3DEG
  11RW 58.8DEG   12DP 63.3DEG


SINGLE SYSTEM LOG   1501

BS1-CLRP-CHILLER PLANT PROFILE
  01EF .855KWT   02$  1131DOL   03EN 26.9MWH   04EN 22.1KTH   05LD 3085TON
  06PR 2641 KW   07CH 13.5KGM   08CD 28.2KGM   09CW 98.9DEG   10SW 45.1DEG
  11RW 58.7DEG   12DP 62.4DEG


SINGLE SYSTEM LOG   1531

BS1-CLRP-CHILLER PLANT PROFILE
  01EF .691KWT
```

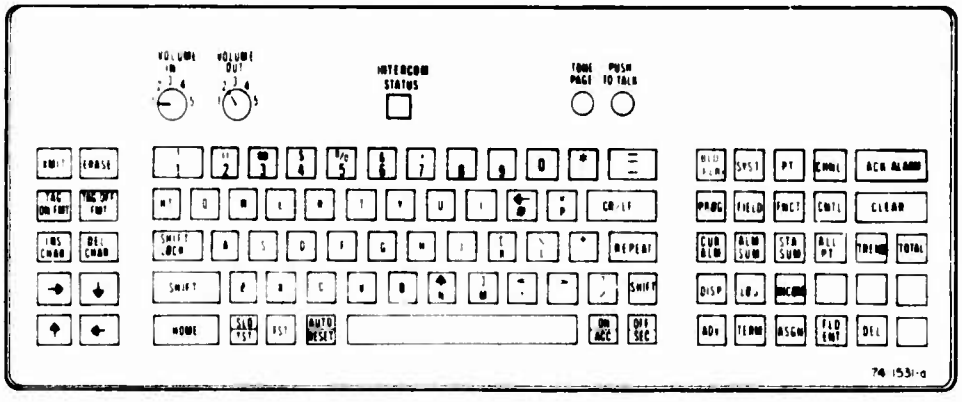
Etc.

CHILLER PLANT LOG PRINTOUT

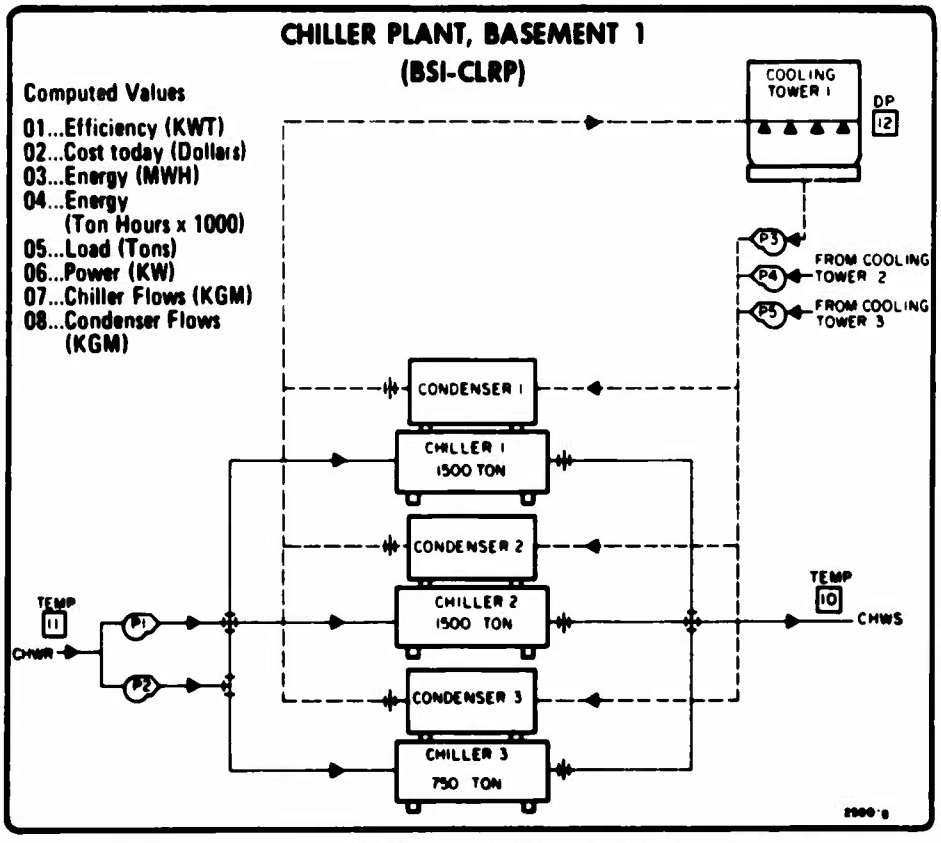
Along with CRT display and log output for each of three chillers (chiller 1 just described), a composite display and hardcopy log may be obtained for the entire chiller plant. The calculated values for the plant are the sum (or ratio) of the three chillers, thus providing a composite picture of plant operation. By establishing profiles of each chiller and the composite plant, procedures can be established for the most efficient operating configurations with varying loads.

```
HØNEYWELL     DELTA 2000     05-16-72   1431HRS      DDF     ØN-LINE
ØPERATIØN     FLR-SYST-PT    EQU-TYP    VALUE        CHNL    HI LIMIT      LØ LIMIT
DISPLAY       BS1-CLRP-07    CH -CAL    11.9KGM      00      0000          0000

                              S Y S T E M   D I S P L A Y

BS1-CLRP-CHILLER PLANT PRØFILE
  01EF .845KWT     02 $ 1131DØL    03EN 26.2MWH    04EN 21.8KTH    05LD 3071TØN
  06PR 2599 KW     07CH 11.9KGM    08CD 28.2KGM    09CW 99.6DEG    10SW 45.3DEG
  11RW 58.8DEG     12DP 63.3DEG
```

CHILLER PLANT CRT DISPLAY

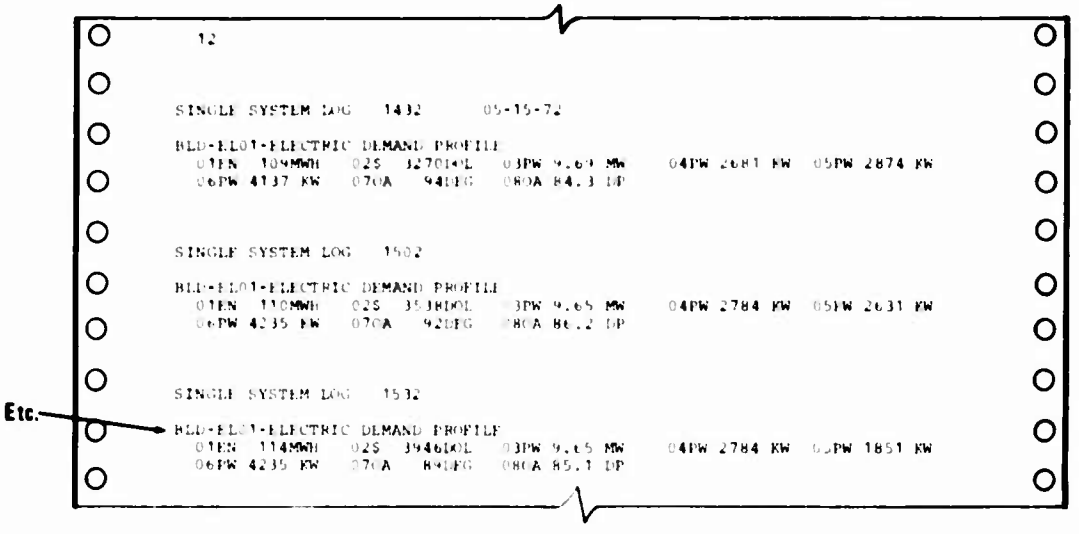


COMPUTER CRT CONSOLE KEYBOARD



CHILLER PLANT GRAPHIC DISPLAY

ELECTRIC ENERGY DISTRIBUTION PROFILE

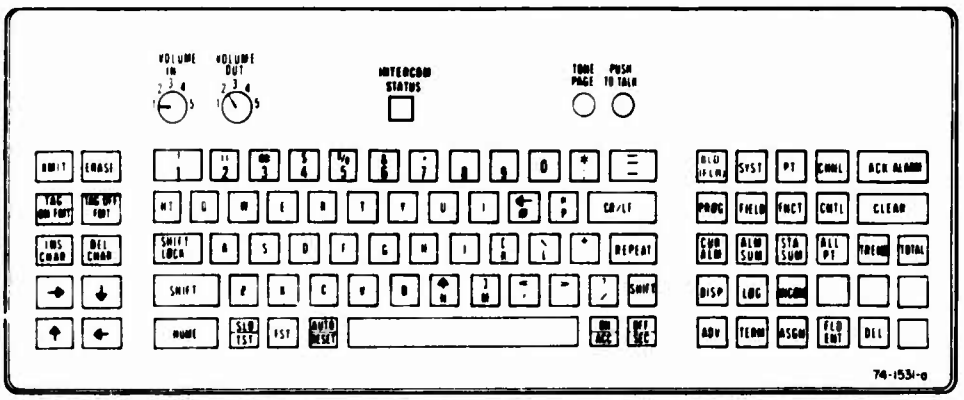


ELECTRIC DEMAND LOG PRINTOUT

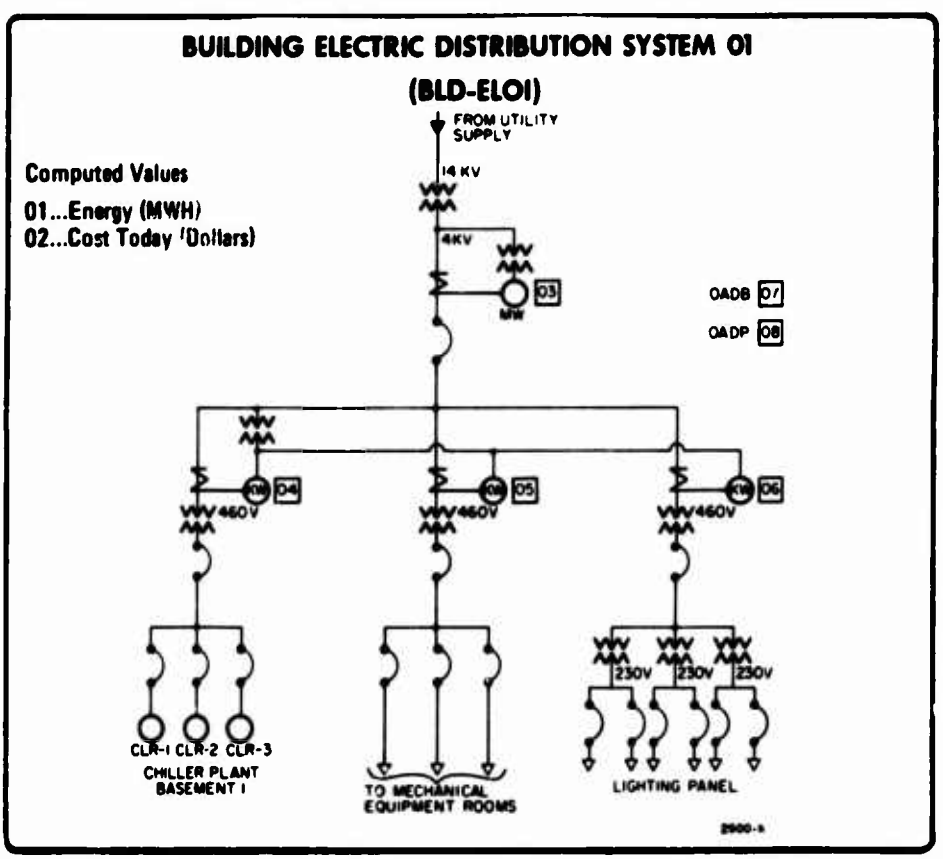
The electric energy distribution system may also be displayed and data logged for the entire building in order to prepare profiles and operating procedures for varying loads. Since billing is based both on energy (MWH) and demand (MW), alarm limits can be set on the amount of power to the building, for example. This will enable the operator to turn off certain loads should an alarm occur and the demand interval start to time out.

```
HONEYWELL     DELTA 2000     05-16-72   1432HRS     ODF     ON-LINE
OPERATION     FLR-SYST-PT    EQU-TYP    VALUE       CHNL    HI LIMIT      LO LIMIT
DISPLAY       BLD-EL01-03    PW -ANA    9.69MW      12      0010          0000

                              S Y S T E M   D I S P L A Y
BLD-EL01-ELECTRIC DEMAND PROFILE
  01EN  109MWH     02 $ 3270DOL    03PW 9.69 MW    04PW 2681 KW    05PW 2874 KW
  06PW 4137 KW     07OA   94DEG    08OA 84.3 DP
```

ELECTRIC DEMAND CRT DISPLAY



COMPUTER CRT CONSOLE KEYBOARD



ELECTRIC DISTRIBUTION SYSTEM GRAPHIC DISPLAY

H316 CALCULATION FORMS

The H316 computer may perform arithmetic operations on any DELTA inputs, or on the previous results of such operations. The resultant display on the CRT, or logging printer output is called a calculation point.

The system permits a maximum of 100 calculation points. Each point may have six variables for inputs, depending on the calculation equation. For example, flow (GPM) might be the first calculation point (07) in a single chiller system (BS1-CLR1). This might be calculated from a single input variable, differential pressure (Δp) as follows:

$$\text{Flow (GPM)} = K\sqrt{\Delta p}$$

where K = 948.6, a constant

and Δp = 0 to 40 in. H_2O

With Δp = 16 in.

$$\text{flow} = 948.6\sqrt{16}\ \text{GPM}$$

$$= 3794.4\ \text{GPM}$$

If the point is selected on the keyboard, the CRT display will indicate that BS1-CLR1-07 is a flow (FL) calculation (CAL) with a present value rounded off to 3794 GPM.

Significantly, calculations may be applied to single system points such as in a single chiller, or to composite systems such as a chiller plant. The composite system calculations generally take the form of plant totals. For example, the flow from a plant with three chillers, might take the sum of the flow from the three individual chillers as the plant total. The instantaneous values for the two chillers at a given time might be:

Flow Point	Value
BS1 - CLR1 - 07	4682 GPM (FL_1)
BS1 - CLR2 - 07	4319 GPM (FL_2)
BS1 - CLR3 - 07	2901 GPM (FL_3)

The formula for the sum of the flow from the two chillers is then:

$$\text{Total flow (KGM)} = K(FL_1 + FL_2 + FL_3) \text{ or } K\sum_{i=1}^{3} FLi$$

where K = 0.001, a scaling factor for thousand gallons per minute (KGM)
gallons per minute (KGM)

With the 2400 HRS values

$$\text{Total flow} = 0.001(4682 + 4319 + 2901)$$

$$= 11.9\ \text{KGM}$$

If the point is selected, or the single system (BS1-CLPT) logged, point 07 is rounded off to 11.9 KGM. All accumulated totalized calculations (except running time) are automatically reset with attendant hardcopy on a daily basis.

In applying calculations, flexibility of the software routines can be enumerated as follows:

- Up to seven 30-character system titles, i.e.,

  CHILLER PLANT PROFILE
  (21-characters including spaces)

- Up to 100 calculation points, i.e.,

EQU-TYP	VALUE
EF -CAL	.603KWT

- Up to 30 calculation equations, i.e.,

$$K\sqrt{\Delta p}$$

- Up to 200 inputs as calculation variables.

- Up to fifteen 2-character equipment type labels, i.e.,

EQU	Meaning
EF	Efficiency
$	Dollars this day
EN	Energy
LD	Load
PR	Power

- Up to fifteen 3-alphabet character analog engineering units, i.e.,

VALUE	Meaning
.603 KWT	Kilowatts per ton
1131 DOL	Dollars
26.2 MWH	Megawatt hours
21.8 KTH	Thousand ton hours
3071 TON	Tons

- Customer determined designator for scaling factors, i.e.,

VALUE	Meaning
964 GPM	Gallons per minute
1.64	Thousand gallons per minute
.240 MGM	Million gallons per minute

- Up to four significant figures for calculated value including decimal point, i.e..

VALUE
9999
99.9
9.99
.999

- When variables are added or subtracted, the engineering unit must be the same, and the decimal point can differ by one (maximum shift is a magnitude of 10), i.e..

VALUE
9.91 KWH
99.3 KWH
9461 KWH (Invalid)

Following are types of calculations and logs most often used to monitor energy usage and costs:

- Single Chiller Log

1. Chiller KWH accumulated and auto reset on a daily basis.
2. Chiller KW/ton calculated from 3 and 8 following.
3. Chiller tons (rate)
4. Chiller ton-hours (BTU) accumulated and auto reset on a daily basis.
5. Chiller $ this day accumulated and auto reset on a daily basis.
6. Chiller flow (rate)
7. Chiller running time accumulated and auto reset on a yearly basis.
8. Chiller KW from kw transducer
9. Chiller status
10. Chiller alarm (on-off)
11. Chiller chilled water supply "DEG"
12. Chiller chilled water return DEG (common)
13. Chiller Condensor water "In" (common)

- Building Chiller Plant Log

1. Plant KWH accumulated and auto reset on a daily basis.
2. Plant KW/ton calculated from 3 and 5 following.
3. Plant tons (rate)
4. Plant tons hour (BTU) accumulated and auto reset on a daily basis.
5. Plant dollars this day accumulated and auto reset on a daily basis.
6. Plant chilled water flow (rate).
7. Plant KW Calculated from last plant KW scan interval.

- Electric Energy Distribution Profile Log

1. Building energy MWH
2. Energy cost $ this day accumulated and auto reset on a daily basis.
3. Building MW

The following enumerates specific calculation forms that may be used:

- Single System Calculations

	Form	Example of Use
1.	Kx_1 (or KN)	KW, KWH
2.	KX_1X_2	Dollars
3.	$K\sqrt{X}$	Flow
4.	$K\frac{X_1}{X_2}$	Ratio, $\frac{KW}{Ton}$
5.	$K(X_3-X_2)\sqrt{X_1}$	BTU/Min
6.	$K(X_1-X_2)$	Differential
7.	$K\sum_{i=1}^{i\leq 6} Xi$	System Totals
8.	X_1/K	Scaling Changes
9.	$(X_3-X_2)\sqrt{X/K}$	Scaling Changes
10.	$X = 1\ Yr$ $\sum X$ on f(t) $X = 0$	Running time hours

- Composite System Calculations

$K\sum_{i=1}^{i<6} Xi$	Plant totals
$K\frac{\sum_{i=1}^{i<6} Xi}{\sum_{l=1}^{i=b} Yi}$	Plant totals
$K\ X_i$	Plant Scaling

Where: K: A field furnished constant or scaling factor for the calculation permissable range is 0.01 to 9999.

Xi, Yi: For single system calculations: A single DELTA input. For composite system calculations: The result of some other calculation.

N: Contact closures proportional to a process variable as defined by the field and accumulated on a standard DELTA totalized card.

NOTE: Other forms can be filled in by the customer.

AUTOMATIC START-STOP PROGRAMS

Start-stop program control provides automatic time programmed operation of motor loads or other operating equipment on preset time schedules. When the H316 computer time equals a specific, stored, program time, points assigned to that program automatically switch to one of two (or three) control positions as the program dictates. Time delay is provided between sequential startups, thus distributing the starting surges of motor loads. Equipment on time programs can also be operated manually at any time, other than automatic program times, simply by displaying the point number and status on the CRT and performing a command function through the keyboard to change the status.

Start-stop program numbers 1 through 50 permit individually stored operating times for two-position control systems such as on-off motor control or day-night changeover control. Individual two-position points may be assigned to either one or two programs, thus providing two start times and two stop times per day, i.e., a morning startup and an evening startup program. Program numbers 51 through 55 permit an additional time setting for a third control position, such as points with on-off-auto or slow-off-fast control. Any piece of operating equipment may be reassigned from any program number to another, or dropped from timed program operation entirely. This is done by assigning program number 00 which is used for equipment which is not to have automatic time program operation.

Each time program permits settings in 24-hour format (0001 to 2400) for weekdays (W), Saturdays (S), and holidays (H) holiday (H), representing both Sunday and holidays. For example, a two-position, start-stop motor point might be assigned to two program numbers with the following schedule:

Day	First Program (No. 09) Morning Start		Second Program (No. 10) Evening Start	
	ON TIME	OFF TIME	ON TIME	OFF TIME
W	0730	1630	1830	2200
S	0730	1300	0000	0000
H	0000	0000	1230	0630

Program times, such as those listed, may be changed at any time by simple keyboard entry.

Further, the system provides an automatic, printed record of all operator changes, such as manual start-stops, program point assignments, and program time changes, and a record of all automatic changes, such as time program startup and shutdown. In addition, the operator can request printout of a start-stop program summary log time information which lists on-off times for each program number; or a single start-stop program summary log point information which lists a single program number, each point assigned, and the present status of each point.

1. UNATTENDED RESTART AFTER POWER FAILURE

In addition to normal, time program operation, program numbers 1 through 10 have an unattended, automatic equipment restart function. Following a power failure, the H316 computer automatically turns itself on when the power is restored. The H316 then automatically turns on all equipment assigned to these programs. This feature assures restart of vital operating equipment.

2. EMERGENCY TIME PROGRAM UPDATE

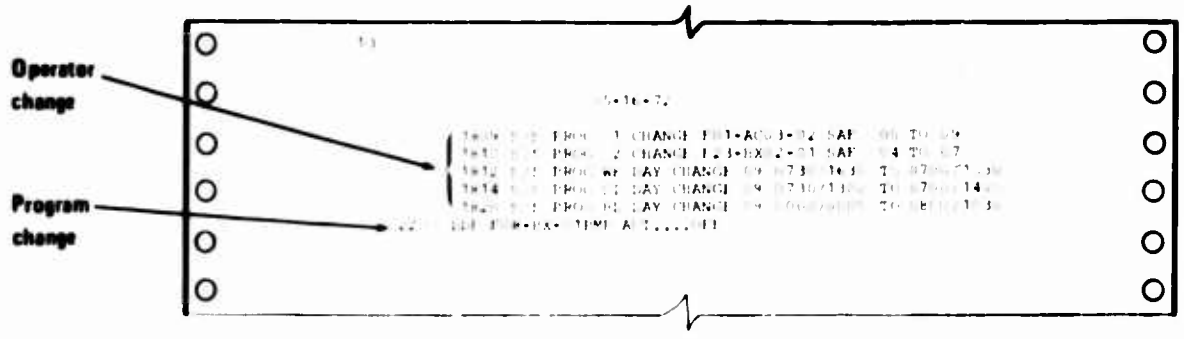
The system also has an attended emergency time program update function. Following the unattended automatic restart, the operator must first enter the correct time and date. The operator then enters the attended time program update function through the keyboard and the time he wishes the update program to work from (typically the time of power failure). The update program then checks all time programs 01 through 55 from the update time to the present time, determines for each piece of equipment if it currently should be on or off, and issues corresponding start-stop commands, thus bringing all programmed equipment up to date.

For example, assume the following programmed equipment is equipped with momentary start-stop equipment, and a 35-minute power failure occurs at 10:00 a.m. on a weekday shutting off all equipment. Then at 10:35 a.m. power is restored, the computer turns on, and SF1, SF2, and SF3 (programs 06, 07, and 08 respectively) are restarted automatically by the unattended restart feature.

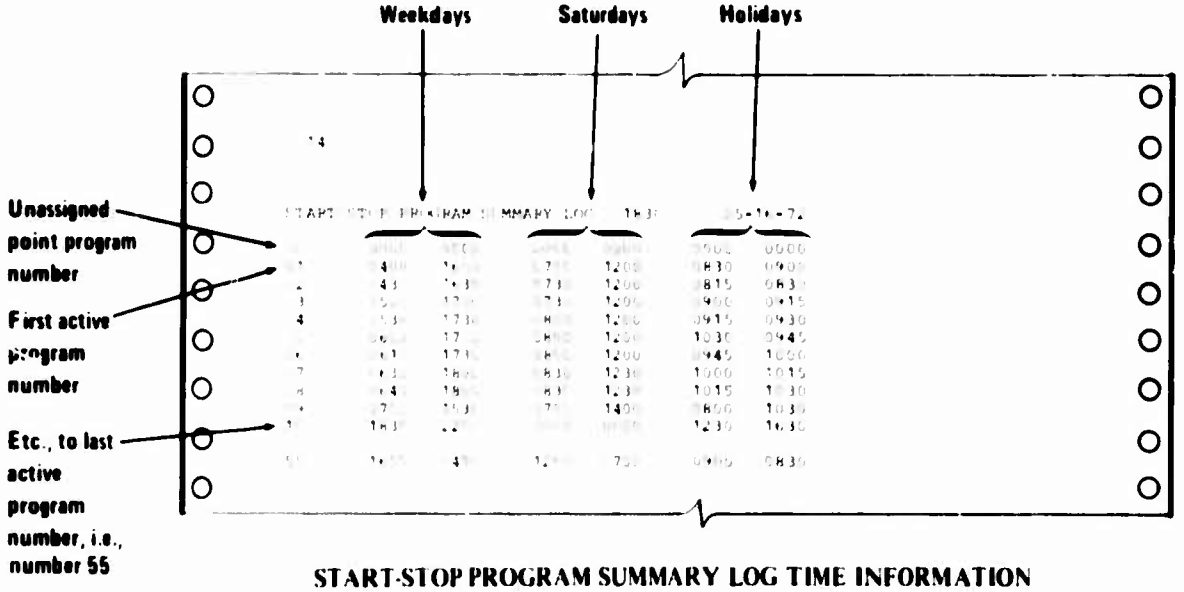
Assuming the operator returns at 10:45 a.m., he then enters the correct time in the CRT display and initiates an attended time program update function via the keyboard. The update program then checks all programs from the power failure time to the present time to determine which equipment should be on or off. In this case SF1, SF2, and SF3 are left on (started at 10:35 a.m. by the unattended restart feature), and SF4, SF5, and SF6 (programs 23, 24, and 25 respectively) are restarted by the update function.

Supply fans SF7 and SF8 (not programmed) remain off until restarted by the operator.

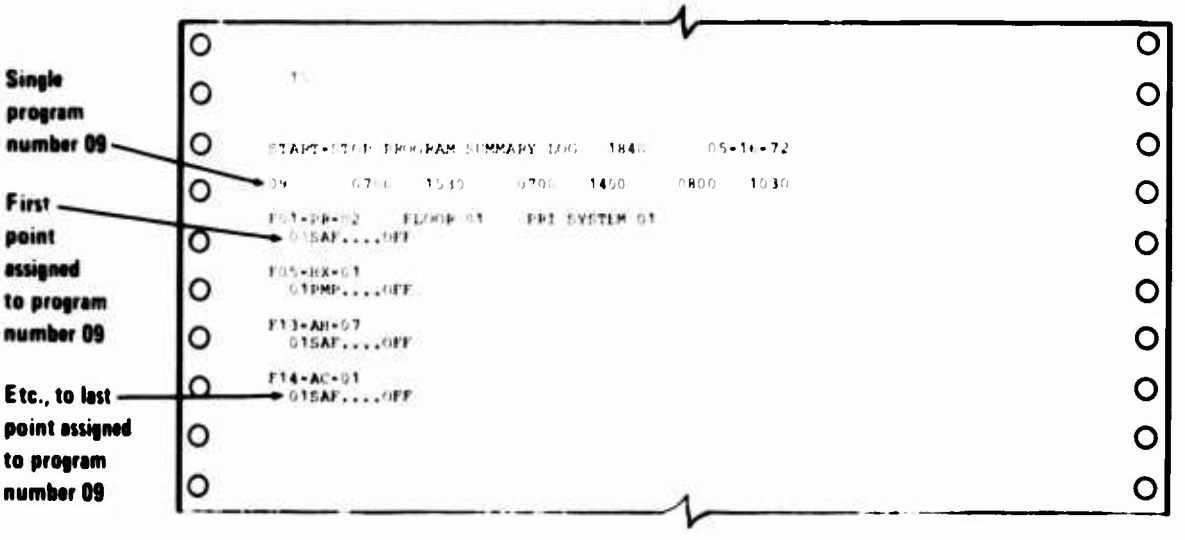
Equipment	Start-Stop Program to Which Assigned	Weekday Start-Stop Times Assigned	
SF1 (Supply Fan 1)	06	0630	1730
SF2	07	0800	1900
SF3	08	0800	1900
SF4	23	0400	1700
SF5	24	0500	1700
SF6	25	0600	2200
SF7	None	–	–
SF8	None	–	–



START-STOP PROGRAM MESSAGE PRINTOUT



START-STOP PROGRAM SUMMARY LOG TIME INFORMATION



START-STOP PROGRAM SUMMARY LOG POINT INFORMATION

PROPERTY AND LIFE PROTECTION

Through the modular features of the **ALPHA/DELTA** Computer System property and life protection systems may be added to a building, or building complex, to provide warning and a course of action in the event of emergencies. Property and life protection systems may include life-safety alarm systems, property protection systems, sprinkler supervisory systems, security alarm systems, and related systems such as CCTV for visual surveillance or an audio link for paging, listening, or evacuating an area. Through the use of the H316 real-time central computer, the property and life protection systems may be arranged into meaningful displays for the guard operating the console.

Utilizing the man-machine interface, the guard may obtain projective graphic displays of single systems, such as fire alarm or security alarms, arranged in a manner that is easiest for him to comprehend. Along with the projected graphic, the guard may obtain a CRT display of the present status of all of the points within the system. And, on demand, he may obtain a log printout of the present status of such points.

With this system, alarm and supervisory points are monitored continually for new alarms and returns to normal. Such events report automatically via the high-speed central processor and printout on the printer. In addition, definite instructions may also be added to the alarm printouts, thus providing the guard with action-taking procedures on alarm occurrence. Further, the printer keeps track of all system changes initiated by the guard, such as secure-access switching, test and reset of alarm devices, watchtour events, etc.

The following discusses asset protection systems commonly used with the **ALPHA/DELTA** Computer System. Included are:

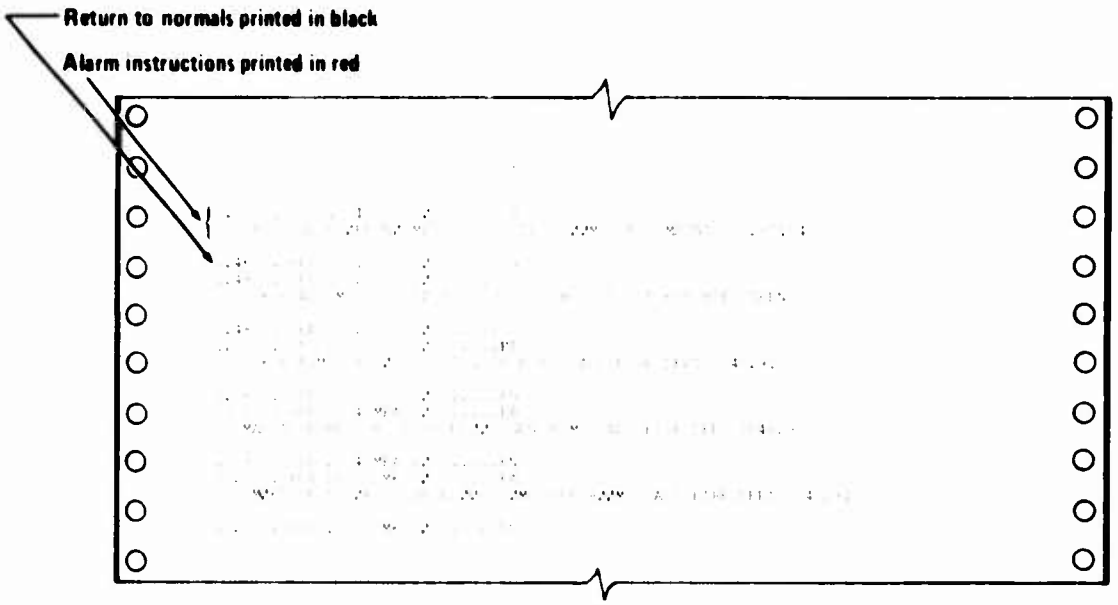
- Fire Alarm Systems
- Security Alarm Systems
- Patrol Tour Systems

FIRE ALARM SYSTEMS

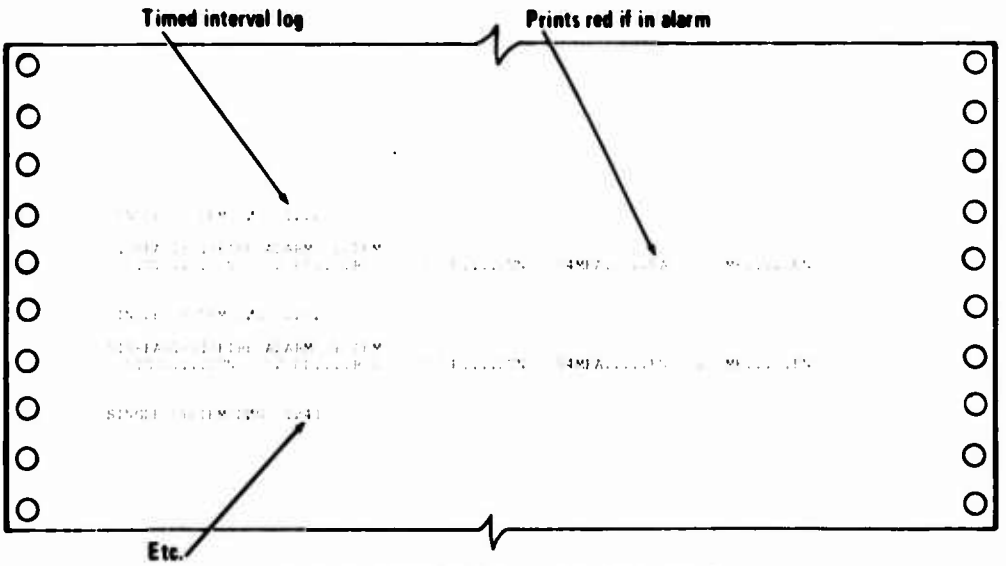
The computer system may be used to monitor the status of all fire alarm panels, detectors, and annunciators. All changes to system conditions are recorded at the console. Alarm occurrences sound a tone and print out in red. The alarm printout includes the date, time, and location, and may include instructions for the guard or operator, such as calling the maintenance department for supervisory alarms or the fire department for fire alarms. The contents of the alarm instructions may be changed by the guard supervisor, if required, to suit changes in operating conditions.

The system also provides a simultaneous, projected, graphic display and CRT data display of any selected, fire alarm system, plus a current alarm display of the ten most recent alarms. In addition, a log printout may be obtained, either on demand or on a timed-interval basis, of any fire alarm system.

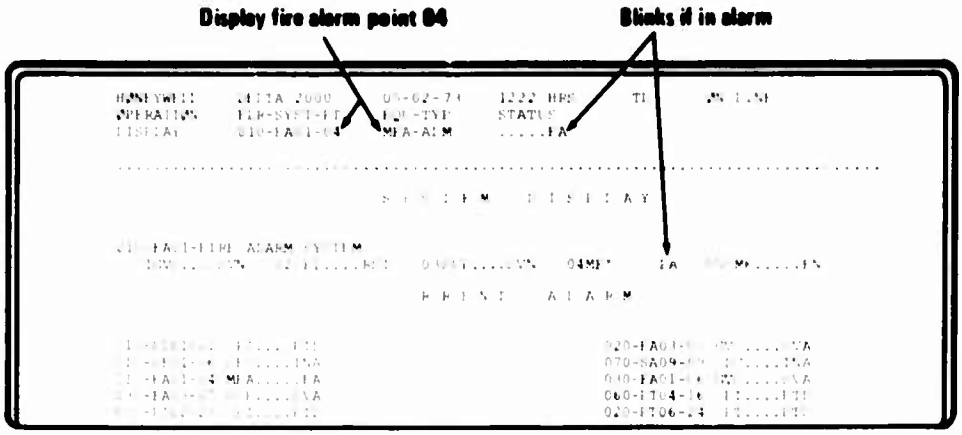
Further, test and reset command functions may be performed from the CRT console for selected, remote, fire alarm points. The printer records both the test operation and the reset.



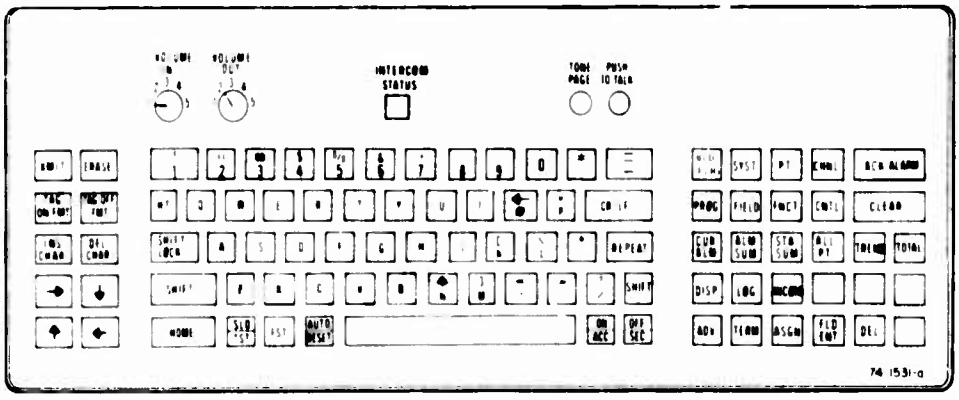
FIRE ALARM SYSTEM ALARM AND RETURN-TO-NORMAL MESSAGE PRINTOUT



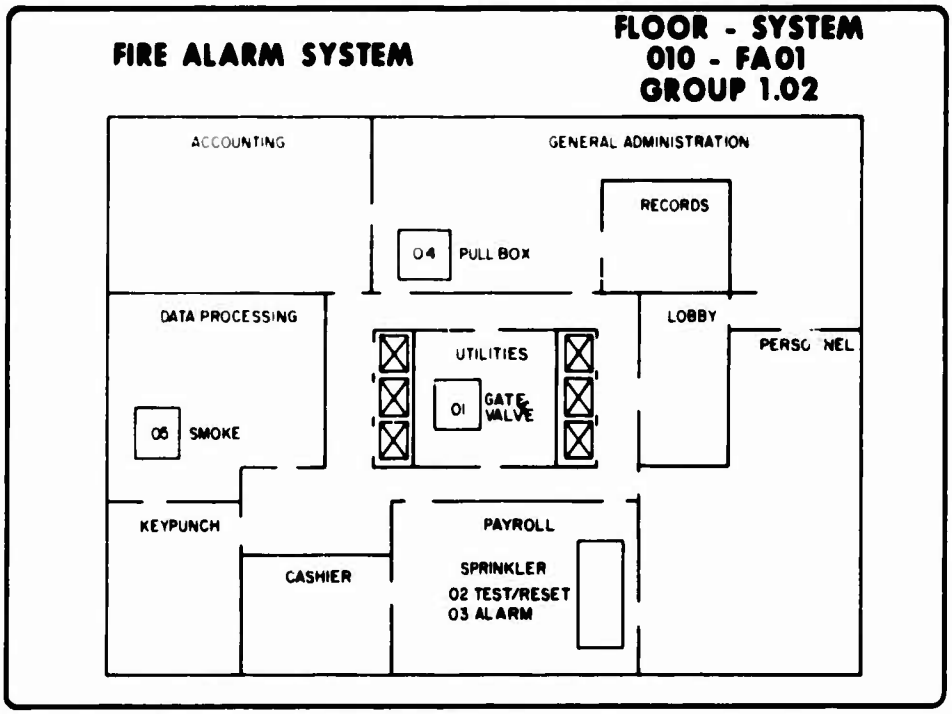
FIRE ALARM SYSTEM LOG PRINTOUT



FIRE ALARM SYSTEM CRT DISPLAY



COMPUTER CRT CONSOLE KEYBOARD



FIRE ALARM SYSTEM GRAPHIC DISPLAY

94<
SECURITY ALARM SYSTEM

The computer system may be used to monitor the status of all security alarm panels and detectors. All changes are recorded at the console. Whenever an intrusion is detected, a tone is sounded and a printout occurs in red. The alarm printout includes the date, time, and location, and may include instructions for the guard or operator such as calling the police department. The contents of the alarm instructions may be changed by the guard supervisor, if required, to suit changes in operating conditions.

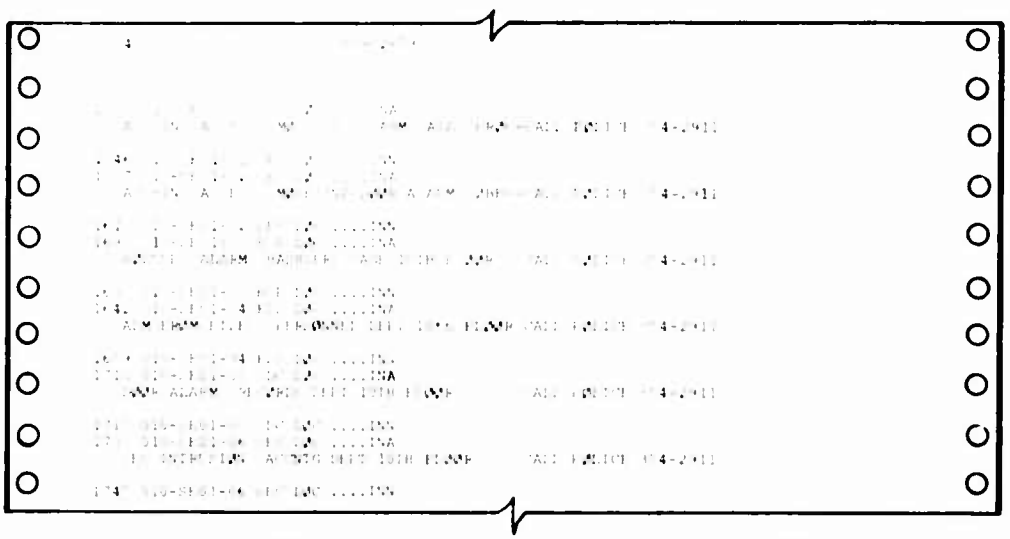
The system also provides a simultaneous, projected, graphic display and CRT data display of any selected, security-alarm system, plus a current alarm display of the most recent alarms. In addition, a log printout may be obtained, either on demand or on a timed-interval basis of any security alarm system.

In addition, the following command functions may be performed from the CRT console:

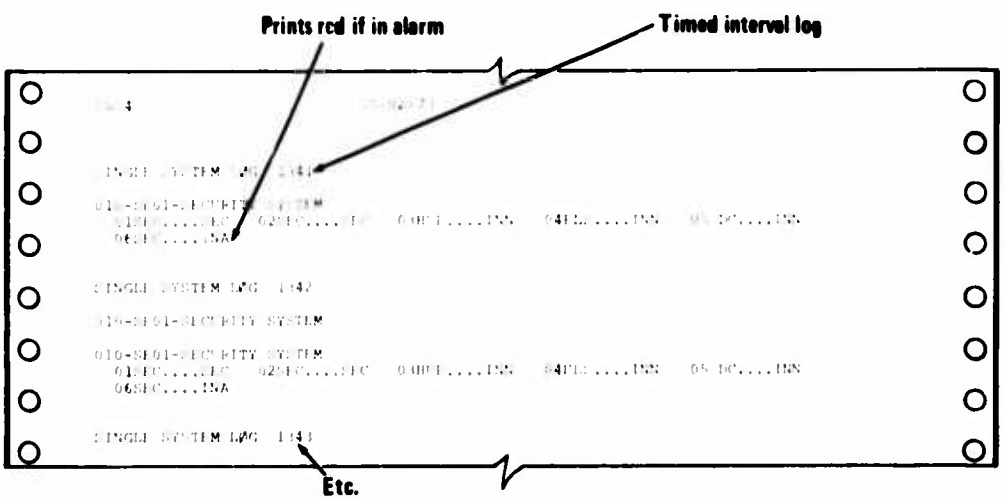
1. Secure/Access — The secure/access function allows selected security systems to be switched from the secure to access and from the access to the secure mode of operation. The printer records both the secure operation and the access.

2. Test/Reset — The test/reset function allows selected security systems to be tested and reset from the central console. The printer records both the test and the reset.

3. Lock/Unlock — The lock/unlock function allows selected doors or gates to be locked or unlocked through the keyboard with immediate confirmation on the printer.

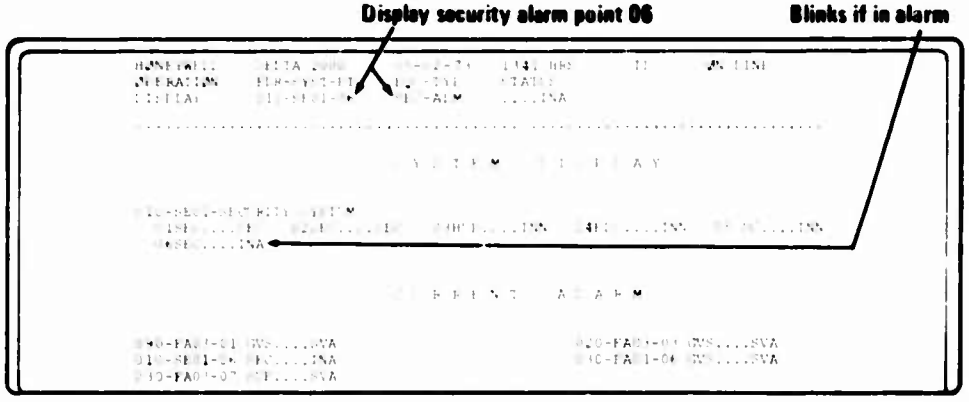


SECURITY ALARM SYSTEM ALARM AND RETURN-TO-NORMAL MESSAGE PRINTOUT

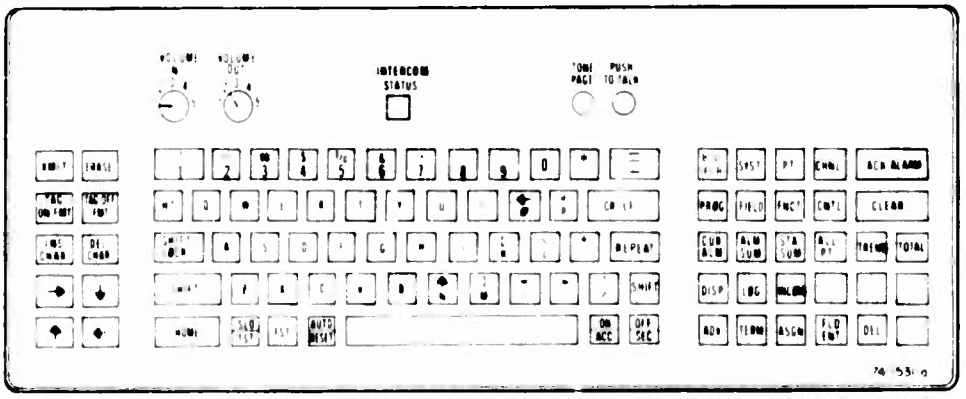


SECURITY ALARM SYSTEM LOG PRINTOUT

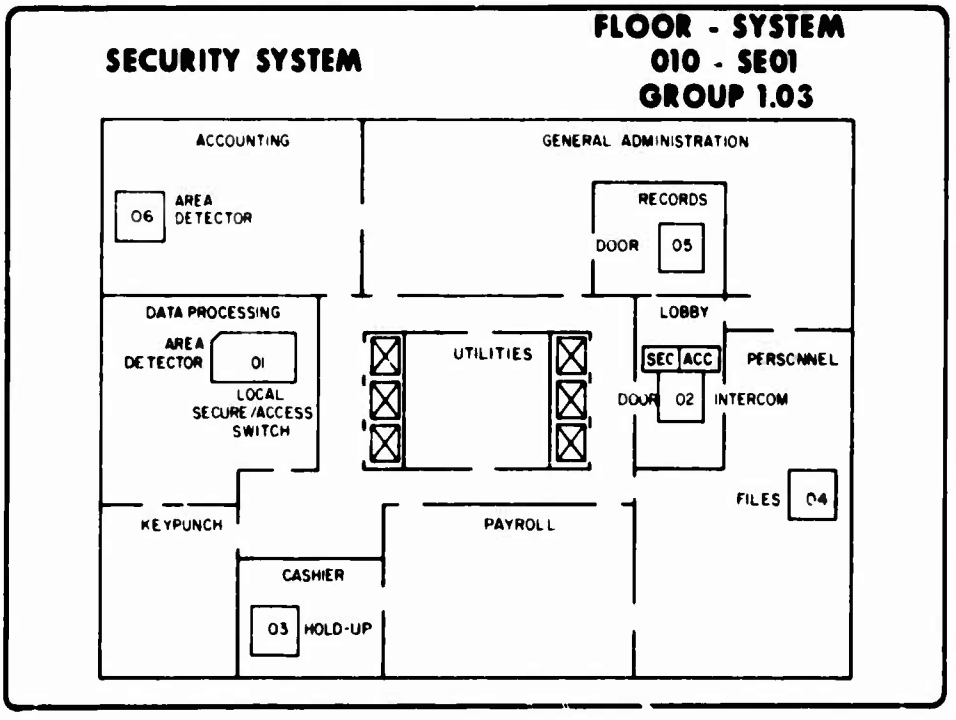
The command functions just mentioned — secure/access, test/reset, lock/unlock — may also be assigned to automatic, time programs. At predetermined times, the computer will automatically execute the programmed commands, and will confirm each command on the printer. At any time, the operator can assume manual control over programmed devices, and he can reprogram the computer times, or point assignments, to accommodate changing conditions while operating the system.



SECURITY ALARM SYSTEM CRT DISPLAY



COMPUTER CRT CONSOLE KEYBOARD



SECURITY SYSTEM GRAPHIC DISPLAY

PATROL TOUR SYSTEM

The computer system may be used to monitor the progress of a guard advancing through a patrol tour. A printout may be obtained including the tour start, each tour station as it is reached, and the tour end. Failure to reach a station on time (time delinquency) or out of sequence events are treated as alarms and sound the tone and printout in red, thus notifying the console operator of the alarm occurrence.

The system also provides a simultaneous, projected, graphic display and CRT data display of any selected, patrol tour system plus a current alarm display if selected. In addition a log printout may be obtained, either on demand or on a timed-interval basis, of the instantaneous status of a patrol tour system.

The patrol tour system has the following functional specifications, depending on the operation desired:

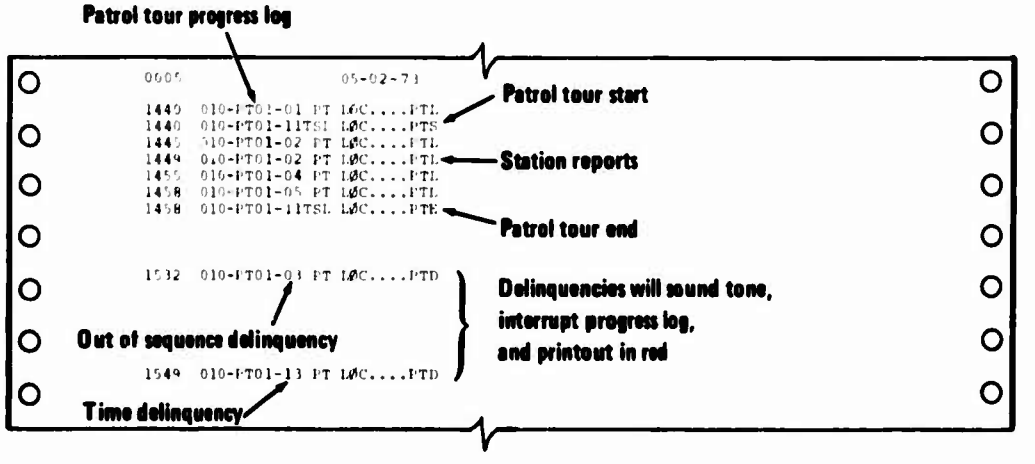
1. Compulsory Patrol Tour: The compulsory patrol tour system performs the function of monitoring, recording, and controlling patrolling guards or watchmen. The basic patrol tour system can accommodate a number of different tours, with from two to thirty stations on each tour. Delinquency alarms are provided for both time and out-of-sequence operations. Each tour has an adjustable time interval between station operations. A time delinquency alarm is recorded and displayed at the central console if the time allotted is exceeded. This supervision protects the guards from mishaps that might go undetected for some time. The system provides two different modes of controlling the tour sequence.

   Optional recall lamps and telephone jacks for intercommunications are available on each station. The recall lamps and telephone jacks for intercommunications are available on each station. The recall lamps can be operated from the central console on a per tour basis.

2. Non-Sequential Patrol Tour: The touring guard reports to the central console by inserting and turning his key at each patrol tour station, while maintaining a pre-set time interval between stations. The time interval between stations may be adjusted for each tour route.

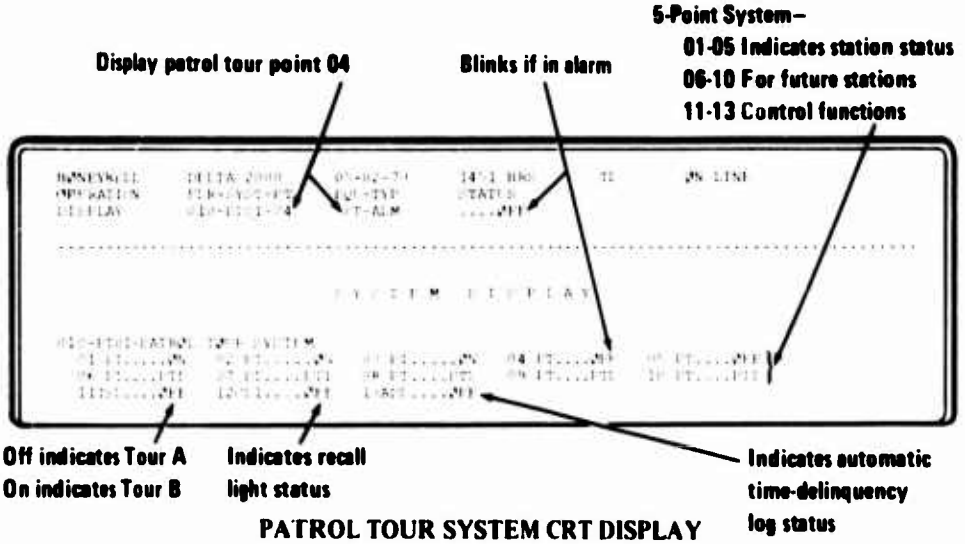
   When the guard begins a tour, the first station number and time prints out automatically at the control center as does the last station number at the end of the tour. In between, the guard may visit stations in any sequence, as long as he maintains the time interval between stations and completes the entire tour.

   If he fails to activate a station within the time interval, the operator receives a delinquency alarm printout. If he completes the overall tour within the total time limit, but a station is missed, the operator also received an alarm printout. In either case, the operator can demand a tour system CRT display or log which will indicate all stations operated and not operated.

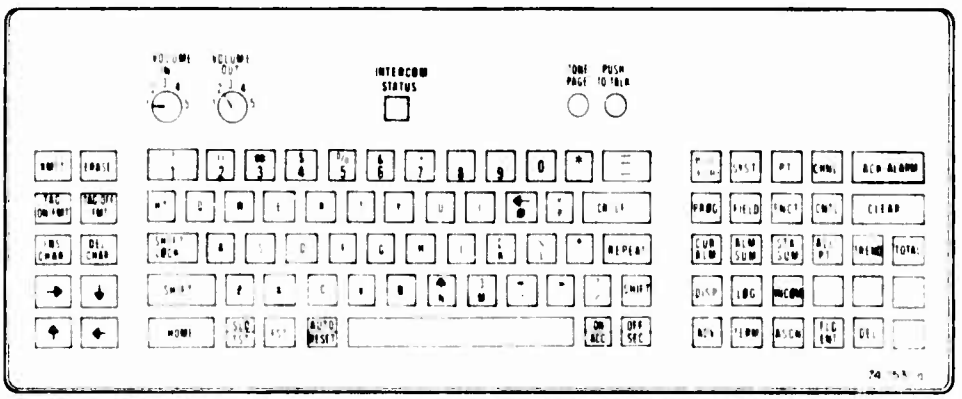


PATROL TOUR AUTOMATIC PROGRESS LOG AND ALARM MESSAGE PRINTOUT

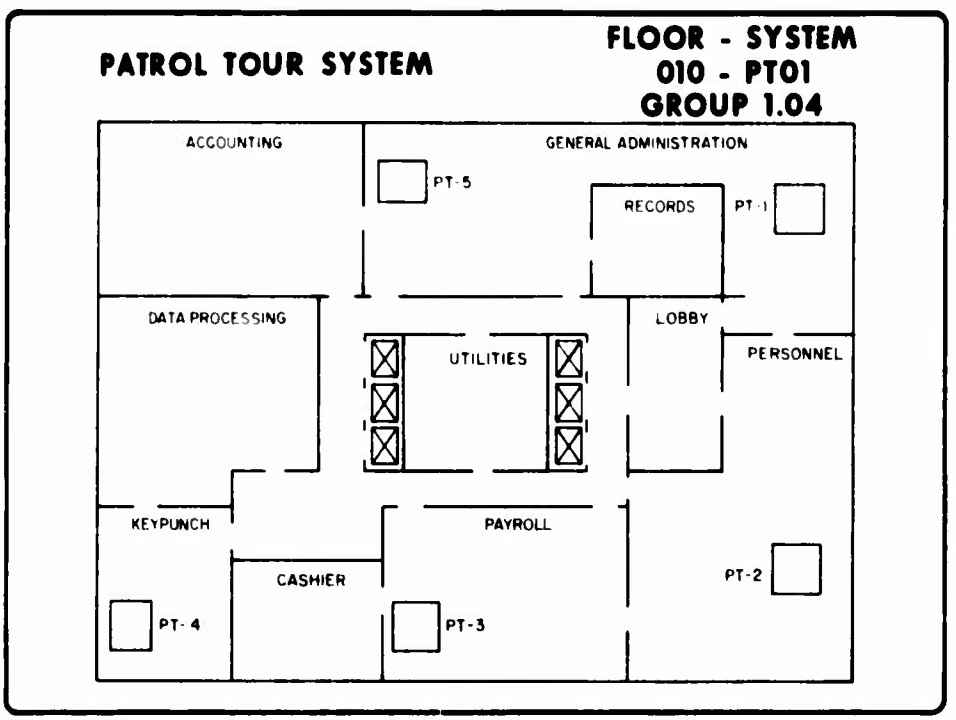
74-1866



PATROL TOUR SYSTEM CRT DISPLAY



COMPUTER CRT CONSOLE KEYBOARD



PATROL TOUR SYSTEM GRAPHIC DISPLAY

74-1866

3. Sequential Patrol Tour: The touring guard reports to the central console by inserting and turning his key at each patrol tour station, while maintaining a pre-set station sequence and time interval between stations. From the central console, the operator may select one of two prescribed routes (Tour A or Tour B) at the beginning of each tour.

   When the guard begins a tour, the first station number, tour start indication and time prints out automatically at the control center as does the last station number at the end of the tour. In between, there is no printout as long as the guard maintains the proper station sequence and time interval.

   If the guard fails to activate a station within the time interval, the operator receives a delinquency alarm printout. If he fails to maintain the proper station sequence, the operator receives an alarm printout identifying the station missed. In either case, the operator can then demand a tour system CRT display or log which will indicate all stations operated and not operated.

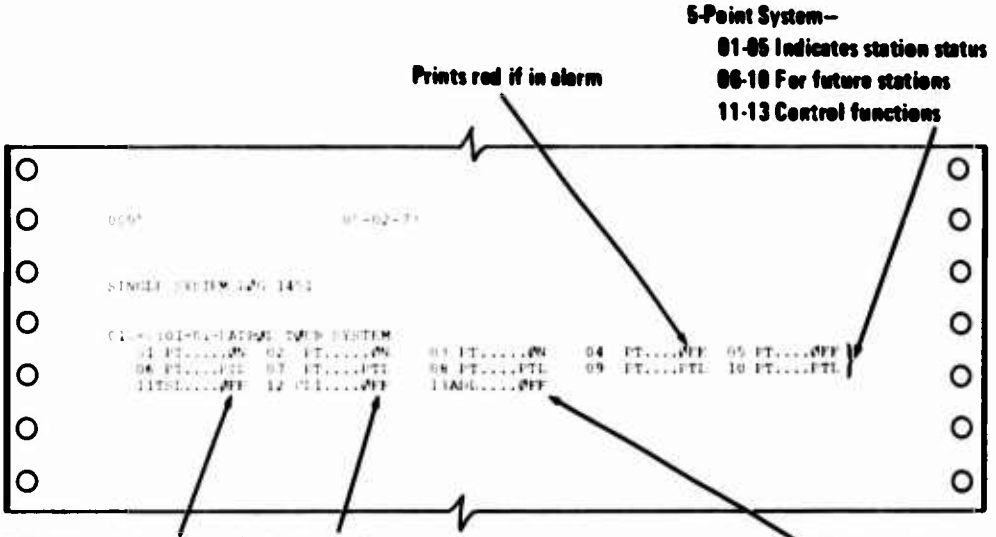
4. Available Features: Listed below are features which may be utilized with the patrol tour system.

   a. Automatic Progress Log — This provides a printout of each station when activated so that the operator can supervise and record tour progress. This feature is useful for training new guards, and breaking in inexperienced guards on new routes. It can be disabled at the CRT keyboard when not in use, in which case the system records tour start, delinquency (if one occurs), and tour end.

   b. Automatic Time Delinquency Log — This provides a printout of all stations that have been operated on a tour when a time delinquency alarm occurs. Only the stations operated prior to the time the delinquency occurs are recorded.

   c. Recall Lights — Lights controlled by the operator are provided at each tour station. When the operator wants a patrolling guard to call in, he lights the recall lamps at all of the stations on that tour. When the guard reaches his next station, he then calls the operator for instructions.

   d. Guard-Operator Communications — Each patrol tour station is equipped with a built-in telephone jack. By plugging in a portable handset at any point along the tour, the guard can communicate with central console operator.



PATROL TOUR SYSTEM LOG PRINTOUT

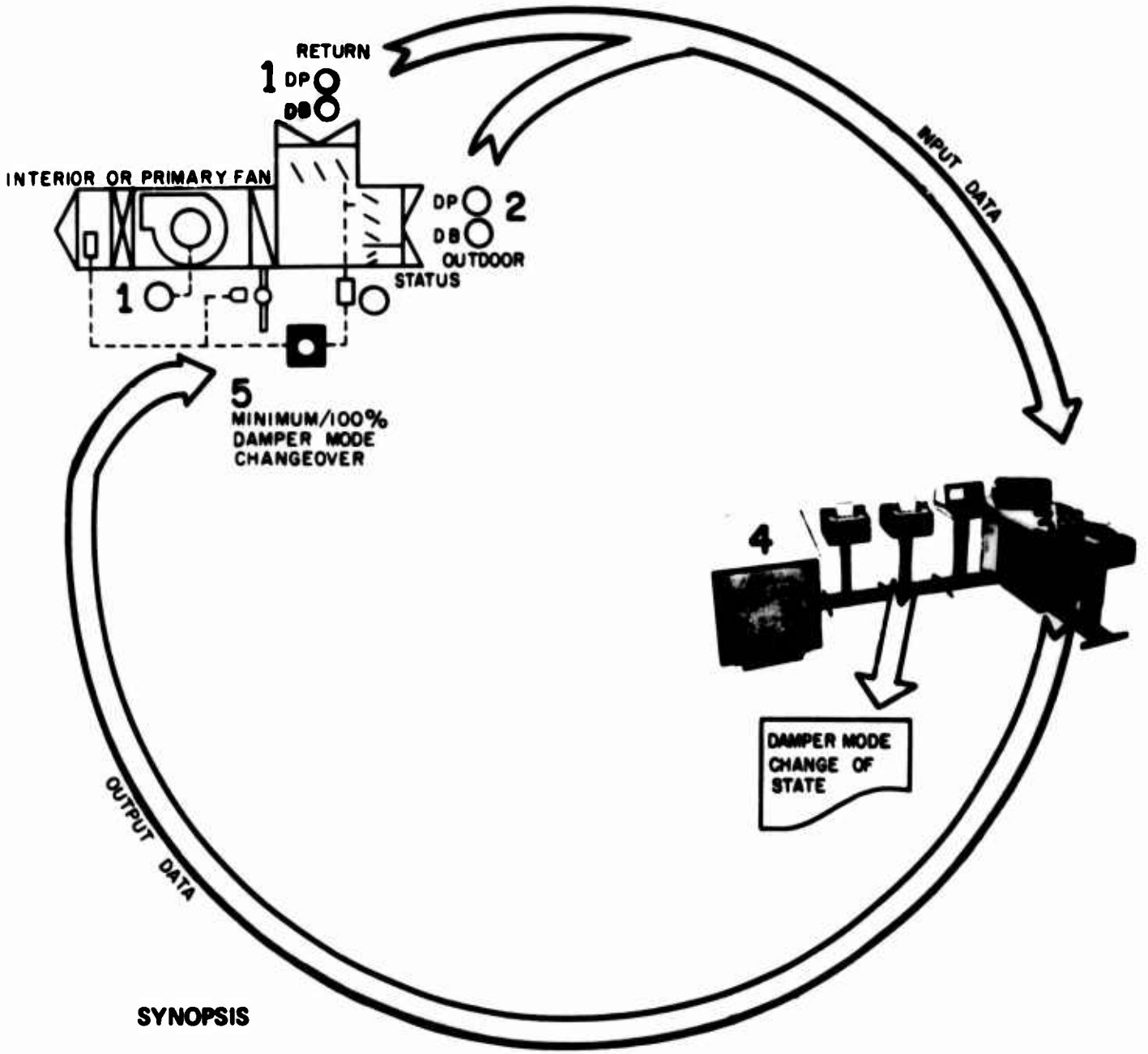
74-1866

OPTIMUM PERFORMANCE, ON-LINE PROGRAMS

The DELTA 2000 Computer System is capable of turning remote systems on or off automatically, or changing modes of operation, without operator attention. In all cases, hardcopy printout is provided, and the operator can overcall the change from the CRT console if desired. The system can also output special alarm and maintenance messages, and be expanded in capacity and functions to meet the needs of any building size or configuration through the addition of bulk memory. Although some operator and hardware features are discussed, the following are primarily on-line functions to provide optimum performance with minimum operator attention. These functions include:

- Optimizing Based on Outdoor Air
- Optimum Start-Time Selection
- Electric Demand Forecast, Profile, and Load Shedding
- Maintenance Instructions
- Alarm Instructions
- Central Control of Lighting

OPTIMIZING BASED ON OUTDOOR AIR



SYNOPSIS

Return air dry bulb and dewpoint (1), outdoor dry bulb and dewpoint (2) and on-off of each air handling system is input to computer via DELTA Processor (3).

Computer program (4) computes and compares total heat of outdoor air and return air. If outdoor total heat is *less* than that of return air, dampers may go to 100% outdoor air under local loop control. If outdoor total heat is *greater* than return air, dampers revert to minimum outdoor air position.

Computer outputs "on" or "off" commands directly to damper mode changeover switch (5) at each air handler.

OPTIMIZATION BASED ON OUTSIDE AIR CONDITIONS

This program measures total heat content of outside air and return air, compares them, and automatically positions dampers to send air having the *lowest* total heat thru the cooling coil. This reduces cooling load and makes maximum use of outdoor air for cooling when outdoor conditions permit.

OPERATING SEQUENCE

Every 20 minutes an enthalpy (total heat) comparison is made between the outdoor and the return air available to a system. Three situations are possible

Area 1 – Outdoor air total heat is greater than total heat of return air. Computer action *closes* outdoor air dampers, permitting maximum return air to enter cooling coil. Minimum OA dampers remain open for ventilation requirements

Area 2 – Outdoor air total heat is *less* than total heat of return air. However, outdoor *dry bulb* is *higher* than dry bulb of return air so outdoor air would still present a larger load than return air.

Computer action *closes* outdoor air dampers permitting maximum return air to enter cooling coil. Minimum OA dampers remain open for ventilation requirements.

Area 3 – Outdoor air total heat *and* dry bulb temperatures are less than total heat and dry bulb of return air.

Computer action enables the local-loop discharge air controller. Normally, this controller will then sequence outdoor dampers, and cooling coil valve on a rise in temperature.

PRINTOUTS

When computer action enables local-loop control, printout will be

0845 034-AC02-02HS OPT OA

When computer action *closes* outdoor air damper, printout will be.

1015 034-AC02-02HS OPT RA

INPUT-OUTPUT SUMMARY

For each air handling system utilizing this program, the following *inputs* will be provided:

- 1 Outdoor dry bulb temperature
- 1 Outdoor dewpoint temperature
- 1 Return air dry bulb temperature
- 1 Return air dewpoint temperature
- 1 Fan Status - on or off

Normally *one* outdoor air measurement will be provided per building, except where size or configuration would permit *different* OA intake conditions.

Return Air plenums supplying several air handling systems will normally have *one* set of DB & DP sensors.

Stored tables in computer memory convert dewpoint and dry bulb measurements to a number representing total heat (enthalpy).

Outputs for each air handling system include:

- 1 On-Off module to change damper mode from local-loop control to RA
  Printouts listed above

OA-RA ENTHALPY SELECTION COMPUTER PROGRAM

AREA

1 ENTHALPY COMPARISON, OA & RA OA WILL BE SET AT MINIMUM

2 ENTHALPY COMPARISON AND DB COMPARISON. OA WILL BE SET AT MINIMUM.

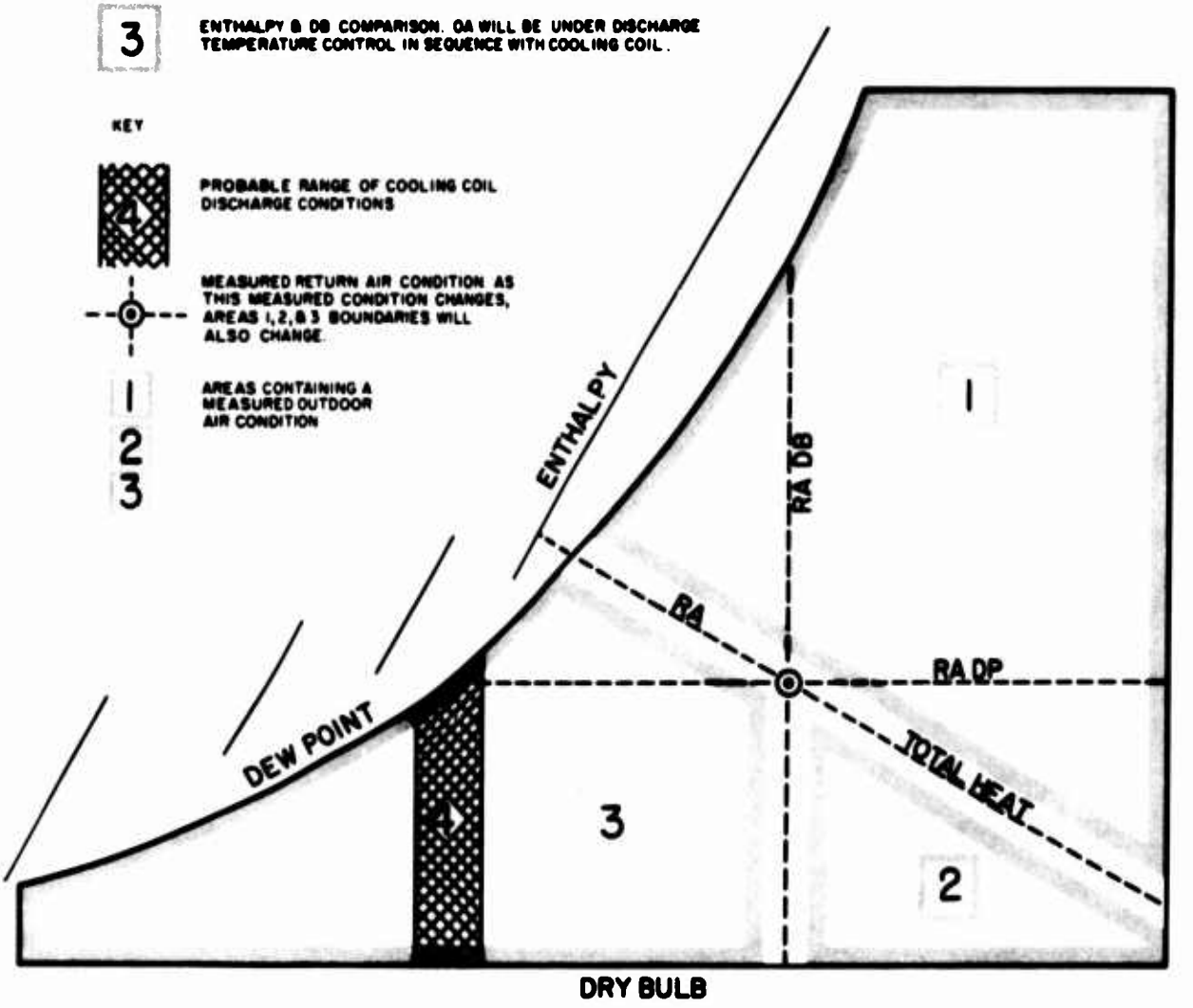
3 ENTHALPY & DB COMPARISON. OA WILL BE UNDER DISCHARGE TEMPERATURE CONTROL IN SEQUENCE WITH COOLING COIL.

KEY

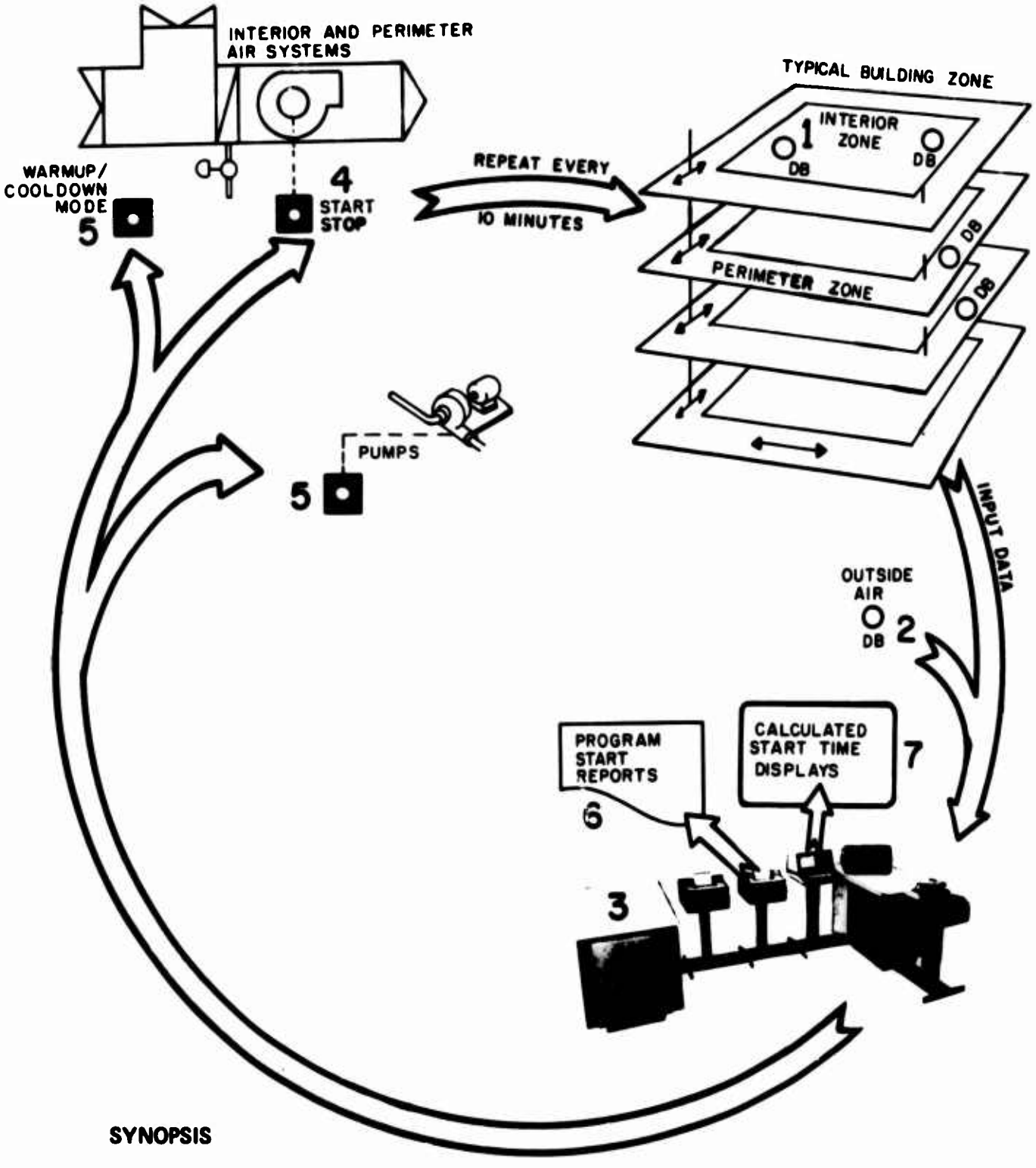
4 PROBABLE RANGE OF COOLING COIL DISCHARGE CONDITIONS

MEASURED RETURN AIR CONDITION AS THIS MEASURED CONDITION CHANGES, AREAS 1, 2, & 3 BOUNDARIES WILL ALSO CHANGE.

1 2 3 AREAS CONTAINING A MEASURED OUTDOOR AIR CONDITION



OPTIMUM START TIME SELECTION



SYNOPSIS

Computer program (3) calculates differences between actual and desired zone temperatures (1) and multiplies this by a factor that varies with outdoor temperature (2), resulting in the required number of minutes before occupancy for starting the air conditioning system.

Start command is sent to the air conditioning system (4) via standard DELTA remote panels. Other equipment, such as warmup-cooldown switches (5), and pumps serving that zone (5) can be assigned using the same inputs but arranged to start, for example, 15 minutes earlier or at the same time.

Operator can request display (7) of calculated start time for any program and printer (6) will record actual starting time for every program.

OPTIMUM START TIME SELECTION

This program operates every morning prior to occupancy of a building or zone. It measures indoor and outdoor conditions and computes the latest start time for heating or cooling equipment that will result in normal comfort conditions by the time of occupancy.

PROGRAM ASSIGNMENT

The zone or system assigned to this program is also assigned to an automatic start-stop program channel. For example:

Point Address	Start Stop Channel	Start Time	Stop Time
33-PA02-01 SUF-S/S	11	0740	1800

This information when displayed via CRT, shows that on floor 33, Primary Air System 02, Point 1, is a supply fan assigned to a start stop function in the program. It is assigned to start-stop channel 11, and this channel has a start time of 7:40 AM and a stop time of 6:00 PM.

7:40 AM is the *latest* on time required, regardless of inside or outside temperatures.

START-TIME CALCULATION

Every 10 minutes, starting at least 4 hours prior to occupancy, outdoor temperature and space conditions in the zone(s) served by "PA02" air handling system are measured, and a new calculation made. This allows the start time to be delayed depending on the current space temperatures, the temperature desired and outside air temperature. An increment of time is selected from a table depending on the absolute difference of the temperature conditions mentioned. This increment of time is then multiplied by a factor which may be different for each optimized start/stop program. This modified increment will decrease the start time according to the calculated lead time necessary for this particular start/stop program.

Each program has individual multiplier values allowed and are all changeable by the console operator. A multiplier number of 0 means program will start at occupancy time.

The above multiplier values may assume values from 0.01 to 9.99. The value is entered, and can be changed, through the CRT keyboard.

For optimum start time programs, the start time is computed by multiplying the time increment by the multiplier value stored. This computed value is then subtracted from the occupancy time for the start/stop program and the result is used as the start time.

The calculation results may be displayed on request via CRT. For example, at 0360, operator wants to know what time a system fan will start. He addresses the point and reads on the CRT:

33-PA02-01 SUF-S/S 0710

INPUTS TO PROGRAM

From 1, 2, or 4 indoor temperatures in a zone or building are measured per assigned program. If it is desired, more points may be averaged via the calculation programs, and results stored in a single address. Any space temperature may be shared between several optimum start channels. In addition, one outdoor DB temperature is measured.

Operator inputs to program via CRT include:

- Start Channel assignment
- Start & Stop Channel Time assignment
- Start time channel multiplier
- Assignment of systems having required inputs to an Optimum Start Channel

OUTPUTS FROM PROGRAM

One or more, up to any desired number of points, may be assigned to a channel. Each channel has a unique set of inputs and will calculate a unique start time.

Outputs are:

- Automatic Start-Stop Command to assigned points.
- Printout that channel has started.
  Example:
  0710 OPT TIME S/S PROG 11 ON
- CRT display of calculated start time.
- Standard start-time channel data printouts.

AUXILIARY FUNCTIONS

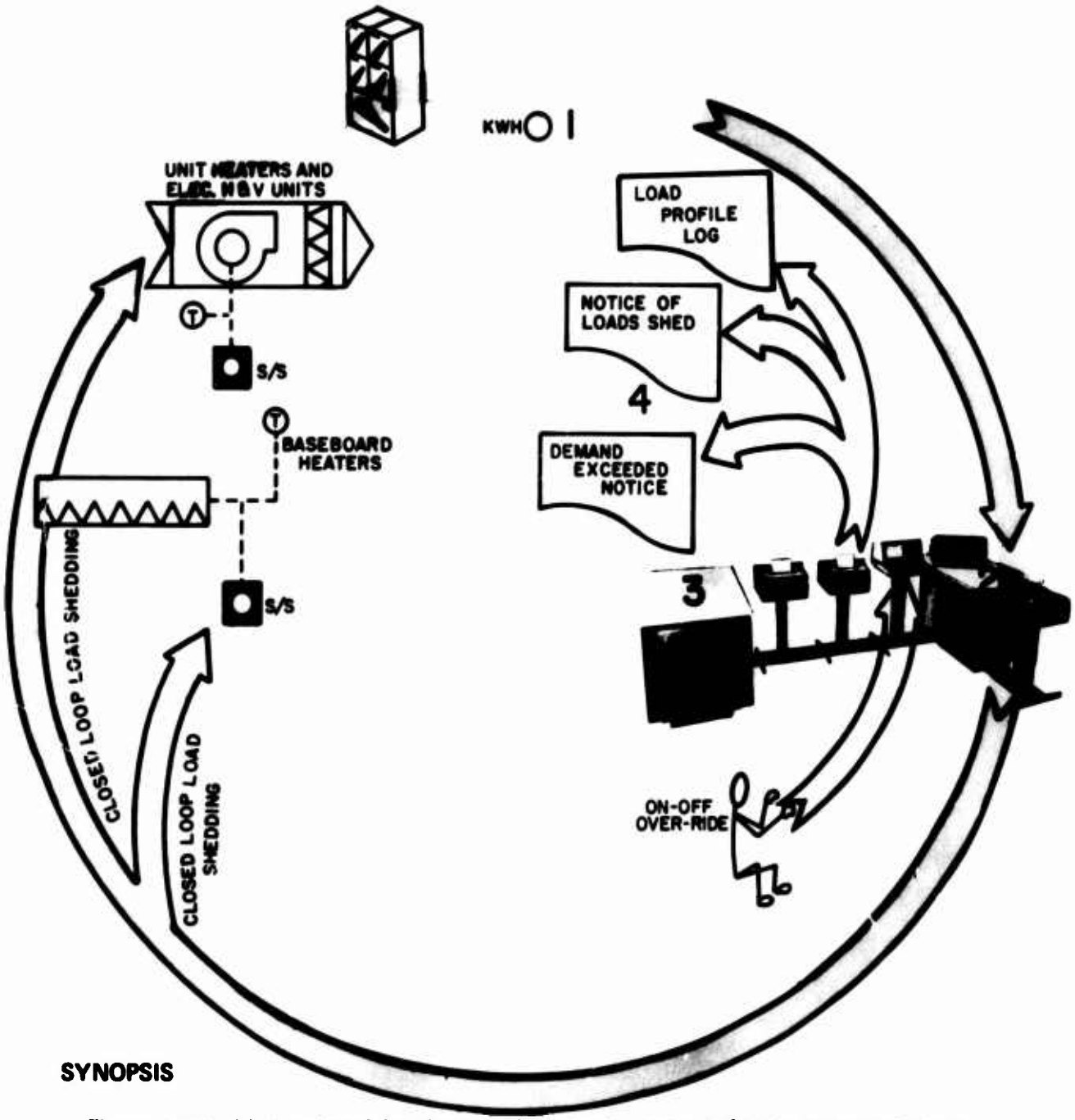
Systems having a "warmup-cooldown" circuit (for example, to prevent use of ventilating air or electric heat reheats when unoccupied) can be programmed so as to always be in the "warmup/cooldown" mode until occupancy, regardless of the time the optimum program actually starts the system.

Systems having auxiliary pumps, chillers c. boilers that are required to start for example 20 minutes in advance of the fan system, are assigned to optimum start channels having the same calculation inputs but with a fixed (latest) start time set 20 minutes earlier.

STOP TIME

No calculations are performed to modify the time a channel will stop.

ELECTRIC DEMAND FORECAST, PROFILE, AND LOAD SHEDDING



SYNOPSIS

- Electric energy (1) is measured by electric utility company meter and input into computer via DELTA Processor (2).
- The program (3) extrapolates power used at 3 minute intervals and predicts and prints out (4) if previous demand will be exceeded in spite of load shedding program.
- The program has a table of 2 groups of loads and sheds group 1 first, then group 2 on a rolling priority basis. Group 3 is also provided which can be shed only by the operator since it could include critical loads. A total of 30 loads may be assigned to Groups 1 and 2, 15 per priority level.
- The computer outputs stop commands to various electric loads and restarts each unit at the end of demand interval.
- Operator can obtain status of all electric loads shown in I/O Summary, as well as current and previous peaks. Every load dumped is recorded on the printer (4) and status, energy and demand values can be logged at hourly intervals (Profile log).

ELECTRIC DEMAND PROGRAMS

ELECTRIC DEMAND DEFINITION

Electrical Demand is the term used by public utilities to describe the maximum rate of use of electrical energy averaged over a demand interval. Utility electrical demand charges are based on the maximum electrical demand, expressed in KW, experienced over a demand charge period specified in utility rates. Typically the demand period is one month, but it could be as long as one year.

KW demand may be defined as the KW load averaged over a specified interval of time. The demand for any given interval is that value of power in KW which, if held constant over the interval, will account for the same consumption of electrical energy as the real power. It is then the average of the real power over the demand interval.

The demand program is based upon the above most commonly accepted definition of demand, usually identified as the block interval method.

AVAILABLE PROGRAMS

The programs available to measure and control electric demand charges are:

- Demand Profile
- Electric Demand Forecast
- Load Shedding

DEMAND PROFILE

The purpose of the demand profile is to:

- Identify at what time demand peaks appear
- Identify what major loads contribute to the peaks
- Suggest candidate loads for manual load shedding

The Demand Profile Log can be generated from any data file points representing electrical load by assigning a composite system consisting of the points desired to be in the profile.

On this basis the Demand Profile Log has the following features:

- Unique identification utilizing one of the seven permissible special system titles, such as "Electric Demand Profile"
- Any 30 system points assignable at time of assembly
- Available upon operator request or on a timed interval basis on logging typewriter
- Capable of display on the System CRT

Utilizing this technique, the Demand Profile Log can be tailored to suit the needs of the job.

ELECTRICAL DEMAND FORECAST

The Electrical Demand Forecast program provides the operator with a warning in the form of an audible alarm and hard copy printout alarm. This alarm and printout occurs before the previous high demand for the month is exceeded and allows the operator to manually reduce electrical loads. The Demand Forecast is generated every 3 minutes and is based on the assumption that the extrapolated load trend seen at that time will continue to the end of the demand interval. If electrical loads cannot be reduced and the previous high demand is exceeded, the demand limit is automatically reset to the new high value.

Every 3 minutes, the program reads the count stored on a remote totalizer card, computes the incremental KW during the sub interval since the last reading, assumes the incremental KW will remain constant and be applicable for each subsequent sub interval remaining in the demand interval, adds this increment for each remaining sub interval to the existing total, and tests to see if the stored maximum limit will be exceeded prior to the end of the interval.

If the test indicates the maximum limit is to be exceeded, a single line of hard copy is generated on the alarm typewriter as follows:

0933 ELECTRIC DEMAND LIMIT # 4 3421 KW WILL BE EXCEEDED BY 0513 AT 0945 HRS.

Operator action is discretionary based upon his knowledge of system loads.

The existing demand limit is capable of display at any time upon operator demand. Additionally, at any time, but usually at the beginning of a new demand period, the operator may reset the demand high limit to a new value based upon experience.

The maximum permissible contact closure rate of the prime metering device is five per second.

DEMAND FORECAST INPUTS

Inputs to this program are:

- 1 or 2 Utility Company demand meters
- Operator demand limit assignment
  Example:
  1545 DLM DEMAND LIMIT CHANGE 03 6430 TO 7120
  Operator's initials

DEMAND FORECAST OUTPUTS

Outputs from this program are:

- Demand exceeded message hard copy and alarm time
- Electric demand limit abort - hard copy messages

The "abort" message is generated from a power failure, transmission failure, or any other interruption of meter outputs on a regular basis.

LOAD SHEDDING

The electrical load shedding program is intended to allow automatic program controlled reduction of electrical load in accordance with the extrapolated predictions of the Demand Forecast program.

The program includes provision for three priority groups of load shedding, only the first two of which are directly under program control. The third is treated as an operator discretionary function based upon program notification that manual intervention is required.

In addition, loads assigned to either priority group 1 or 2 are energized and deenergized on a rolling sequential basis either individually or in multiple according to their tabulated total and the need of the forecast program. At the end of each interval, the program reenables only those loads which it has shut down and stores the location of the first (next sequential) load to be shed in each priority group during the following interval, if required.

If the program calculation and load shedding action is adequate to allow predicted load to fall within the maximum stored demand limit for the interval, no Demand Forecast alarm message is output. If the Demand Forecast is such as to indicate that shedding of all assigned priority Group 1 and 2 loads would not prevent exceeding the maximum limit, a dual message is output on the alarm typewriter. For example:

0933 ELECTRIC DEMAND LIMIT # 4 3421 KW WILL BE EXCEEDED BY 0513 KW AT 0945
ALL LOADS ELEC. DEMAND GPS 1 & 2 OFF. ACTION NEEDED

All loads that could be assigned to load shedding are determined at the time of program assembly and their KW noted and stored. The operator can re-assign or delete any of these points to or from either group 1 or 2 but has no control of the sequence as established automatically for each reentered load by the program in the first unassigned table location.

If a load is deleted from the program by operator action, it remains inactive in the program until reentered by operator.

The operator retains full manual control of any load contained in this program. Automatic and Optimum Start Time functions for load items of this program remain fully functional.

Normal change of status messages will be output on the alarm typewriter upon program action during shedding operations. For example:

0720 033-PA03-06 REH-SS ØFF OPT

This means point 06, a reheat zone, was shut off by the load shedding program at 7:20 AM.

LOAD SHEDDING INPUTS

The following inputs may be assigned to this program:

- 15 loads* for Group 1
- 15 loads* for Group 2
- Loads* as required for Group 3
  *Nominal KW rating is stored for each load
- Electric utility demand meter

Console Inputs are:

- Delete loads from Groups 1 or 2
- Reassign (only) loads to Groups 1 or 2
- Manual override (on or off) for any assign load in any group
- Manual shedding (only) for Group 3 loads

LOAD SHEDDING OUTPUTS

The following outputs are available from this program:

- Demand Forecast Alarm Message
- Demand Forecast Auto limit reset message
- Demand Forecast limit reset by operator message
- Demand Forecast program abort message
- Load Shedding Intervention request message if load shedding is indicated
- Annotated change of status message on load shedding
- Display of existing limit upon operator request
- Display of present extrapolated demand for interval in progress
- Load Shedding on-off control to 30 start-stop modules with change-of-status message if load shedding is included

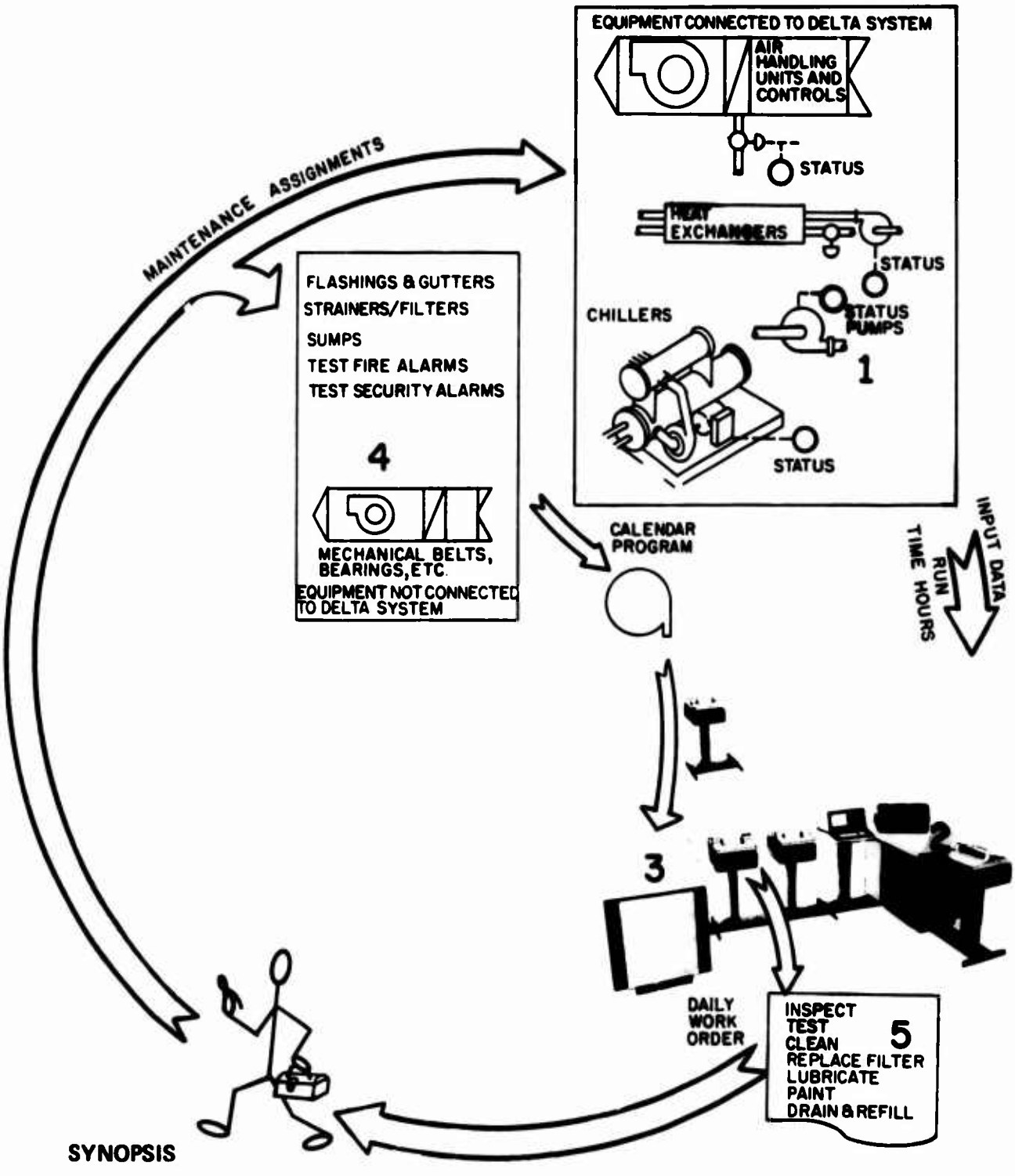
PROGRAM SPECIFICATIONS

The electrical demand program is subject to the following conditions:

The maximum permissible contact closure rate of the prime metering device is 5/second.

- One demand program is required for each group of one or two electric utility KW demand meter inputs. If additional inputs are required, a second program is required.
- All programs required on any given job must contain identical features: i.e., forecast, profile, shedding.
- The program is designed to function with block interval type utility meter instrumentation only.

MAINTENANCE INSTRUCTIONS



SYNOPSIS

- Any equipment (1) listed in the *i*/O Summary for start-stop *or* run status indication can be specified for this program and run-time hours will be monitored via DELTA Processor (2) and stored in computer memory (3).

- Equipment (4) specified by the owner can be identified and stored in computer memory (3) for the calendar portion of this program.

- Program (3) outputs, once a day, a list (5) of equipment due for preventative maintenance with a brief task description. Either accumulated run time or calendar time can generate a maintenance message.

MAINTENANCE INSTRUCTIONS

The intent of this program is to inform the operator whenever specific equipment items are due for scheduled maintenance work, based on either:

1. Accumulated Run Time, or
2. Elapsed Calendar Time.

Once a day, all maintenance tasks which have become due will be typed out. The message will be typed on two lines with the time interval and point identification on the first line, and the corresponding operator-entered message on the second. Any selected time of day may be specified for printer output of due maintenance tasks.

Each message may be individually constructed and entered into memory by the operator, using the CRT keyboard and display. Each message consists of words, abbreviations and numbers, containing no more than the specified number of characters, including any alphanumeric symbols and spaces. Any message may be changed at any time by the operator.

Any stored message may be assigned as the output message for any of three run time intervals or calendar time intervals for any point in the maintenance message program. Assignments are made via the CRT keyboard and display, and may be displayed upon operator request. A typeout will record all operator assignments on the alarm typewriter.

The maintenance messages proper (second line of copy) can have up to a maximum of 60 characters, including spaces. Number of messages, length of messages, and number of points assigned is a function of the memory capacity furnished.

The times for each equipment item are accumulated in hours by the program, with 1/4 hour sampling from status inputs for running time points and 24 HRS/DAY for all calendar time points. The running time totalizer in memory accumulates to a maximum of 10,000 HRS or 10,000 DAYS.

Inputs to this program are field status contacts for the running time points and 24 hours/day for all calendar time points. Any desired points may be specified for assignment to this program and they will be incorporated into the data file. They are specified as either "running time" or "calendar time", but not both.

A maximum of nine maintenance intervals each for both running time and calendar time are user determined but are specified for factory program assembly. Examples of typical assignments are:

Running Time:	Calendar Time:
1. 40 HRS	1. 1 DAY
2. 100 HRS	2. 7 DAY
3. 200 HRS	3. 14 DAY
4. 500 HRS	4. 30 DAY
5. 1000 HRS	5. 60 DAY
6. 2000 HRS	6. 120 DAY
7. 2500 HRS	7. 180 DAY
8. 5000 HRS	8. 365 DAY
9. 9999 HRS	9. 730 DAY

Maximum permissible intervals are 9999 HRS (nominal 10,000) and 9999 DAY (nominal 10,000). Minimum permissible intervals are 24 HRS. and 1 DAY.

TYPICAL OPERATING SEQUENCE

At 0800, the following messages, for example, could print out.

MAINTENANCE LOG 0800

B03-MS01-06 PMP 14 DAY
TEST PUMP
034-PA02-01 FAN 2000 HRS
LUBE, BELT INSP
... 042-RF01-01 ROF 120 DAY

... INDICATES TASK NOT REPORTED DONE FROM PREVIOUS DAY

INPUTS TO PROGRAM

Following are field inputs to this program.

- Calendar time in days
- Run time from status contacts

Following are console operator inputs.

- Maintenance message change
- Maintenance message assignment to a point
- Maintenance task completed

Each data point address can be assigned to point out at (3) three different elapsed times, each time with a different message, for example:

Point identity and first message after 100 hours

034 - PA02 - 01 FAN 100 HRS
START/STOP BELT TENS. LUBE

After 200 hours, this would print out:

034 0 PA02 - 01 FAN 200 HRS
START/STOP BELT TENS. LUBE

After 300, 400, 500, etc. hours the above would repeat.

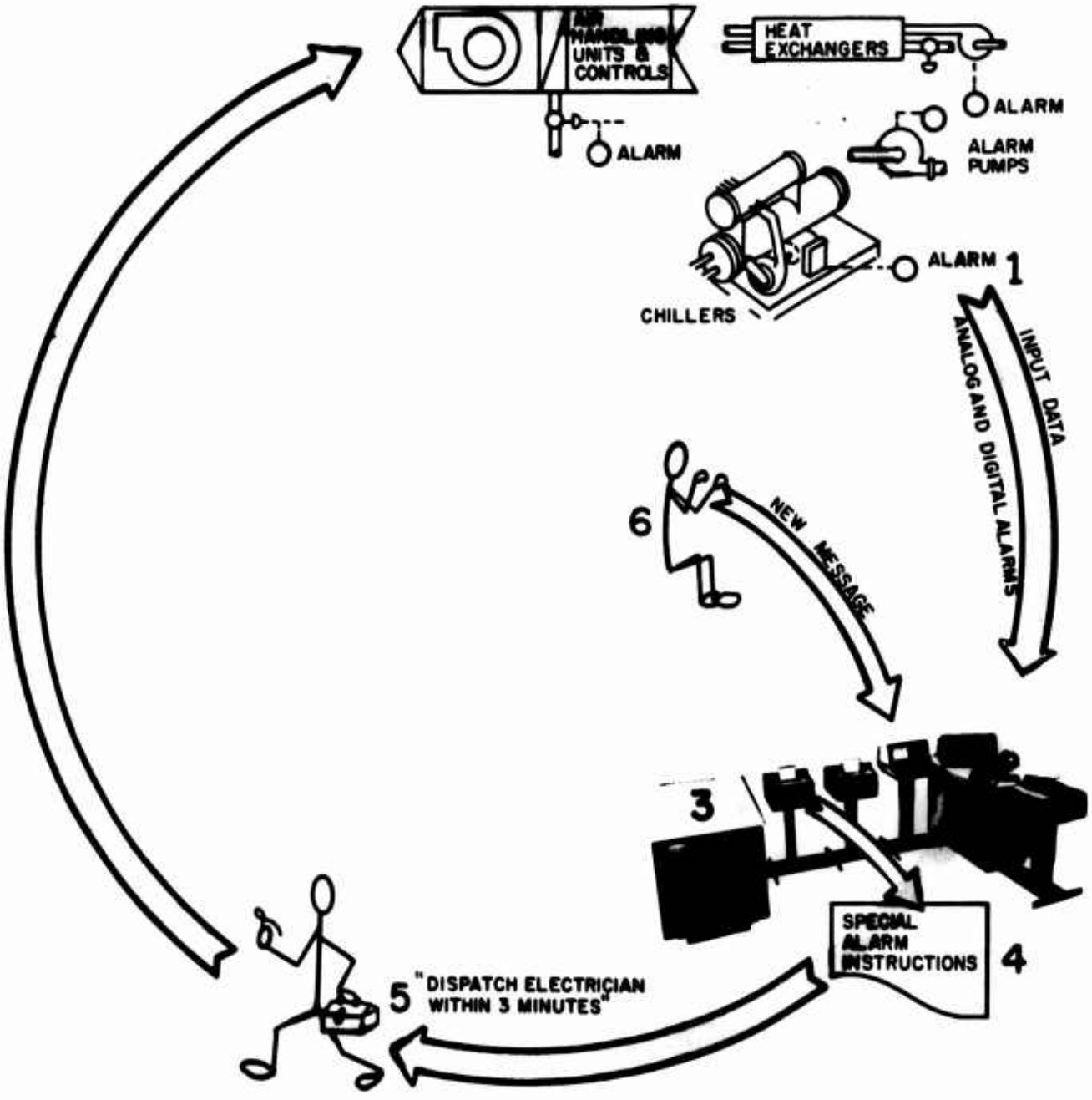
After 1000 hours, printout would be:

034 - PA02 - 01 FAN 1000 HRS
START/STOP BELT TENS. LUBE
STOP & VAC. PLENUM CLN. BLADES

After 2000, 3000, etc. hours above message repeats.

A third message could be assigned to print out at a third designated interval.

ALARM INSTRUCTIONS



SYNOPSIS

- Any analog or digital alarm point (1) can be assigned an alarm message (4).
- Occurrence of alarm causes a special message to print out (5).
- Console operator (6) can type in new messages and assignments.
- Provides written instructions to new operators.

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ALARM INSTRUCTIONS

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This program applies to any alarm input digital or analog, when it changes state, or goes beyond assigned limits, and causes a stored instruction to print out on the alarm printer. The purpose of the alarm printout is to give the console operator specific action instructions for critical alarms or instructions for urgent maintenance tasks that might be called for by the closing of an alarm contact or by an analog or calculated point going into an alarm condition.

A typical alarm instruction might be:

0706 034-HV01-10RH HI 84.0 DEG (Prints red)
PHONE SUPER. CLOSE V16A (Prints red)

The console operator having level 2 access can change alarm messages, and assignment of alarm messages to individual data points.

CAPACITY

Alarm messages may be up to 60 characters in length.

Number of points that may have alarm messages assigned is a function of the memory capacity furnished.

INPUTS AND OUTPUTS

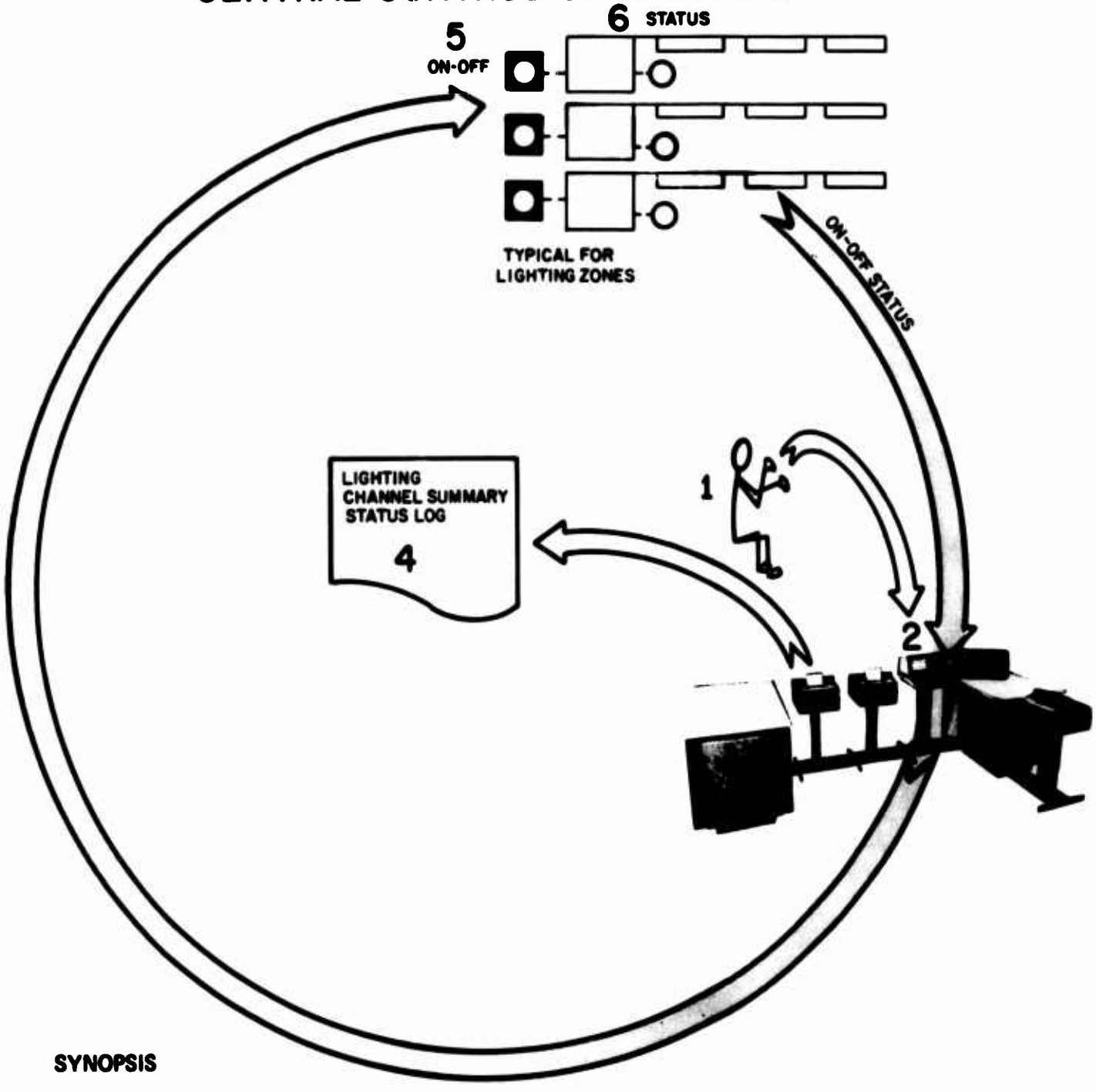
Inputs are:

Any alarm contact or analog input
Change message via keyboard
Change assignments via keyboard

Outputs are:

Alarm messages printed in red
Record of change in message assignment
Record of change of message

CENTRAL CONTROL OF LIGHTING



SYNOPSIS

Console operator (1) establishes desired on and off times for centrally controlled lighting zones and stores these times and channel assignments via the CRT console keyboard (2). The stored program (3) generates an "on" or "off" signal to lighting zone contactors (5). On or off status (6) is fed back to computer memory (3) and used to update lighting status logs (4).

CENTRAL LIGHTING CONTROL PROGRAMS

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Lighting program control provides automatic time programmed operation of lighting zones on preset time schedules. On time program operation, when the H316 computer time equals a specific, stored, program time, points assigned to that program automatically switch to "on" or "off" position as the program dictates. Time delay is provided between sequential startups, thus distributing the starting surges of loads. Zones on time programs can also be operated manually at any time, other than automatic program times, simply by displaying the point number and status on the CRT and performing a command function through the keyboard to change the status.

Program numbers 35 through 49 may be reserved for lighting programs. Individual zones may be assigned to either one or two programs, thus providing two on times and two off times per day, i.e., a morning startup and an evening "janitorial program". Any zone may be reassigned from any program number to another, or dropped from timed program operation entirely. This is done by assigning program number 00 which is used for lighting which is not to have automatic time program operation.

Each time program permits setting in 24-hour format (0001 to 2400) for weekdays (W), Saturdays (S), and holidays (H) holiday (H), representing both Sunday and holidays. For example, a zone point might be assigned to two program numbers with the following schedule.

Day	First Program (No. 09) Morning Start		Second Program (No. 10) Evening Start	
	ON TIME	OFF TIME	ON TIME	OFF TIME
W	0730	1630	1830	2200
S	0730	1300	0000	0000
H	0000	0000	1230	0630

Program times, such as those listed, may be changed at any time by simple keyboard entry.

Further, the system provides an automatic, printed record of all operator changes, such as manual on and off, program point assignments, and program time changes; and a record of all automatic changes, such as time program startup and shutdown. In addition, the operator can request printout of a program summary log which lists on-off times for each program number; or a single program summary log which lists a single program number, each point assigned, and the present status of each point.

MANAGEMENT INFORMATION

One of the very real benefits offered by DELTA 2000 Computer System is usable management information. Building operating data can be presented in a number of ways.

HARDCOPY RECORDS

A Teletype printer records all alarms, operator changes, and log information (see next page).

Utility logging permits a daily review of performance of major equipment such as chillers and boilers. These ratios, plus daily totals recorded at hourly intervals for chilled water, steam, and electricity consumed can quickly reveal conditions causing high energy costs.

COMPUTER ANALYZED TOTAL COST AND EFFICIENCY

The system can be used to deliver performance records for building management. It can compute ratios of input to output energy. These ratios, plus daily totals recorded at hourly intervals for chilled water, steam and electricity can be initiated to help in diagnosis of low efficiencies.

The computer can reduce the volume of information, making it more usable. This information can then be put to use to help analyze cost efficiency of the building, measure efficiency of a particular system and thus let them more effectively schedule personnel to perform needed or preventative maintenance.

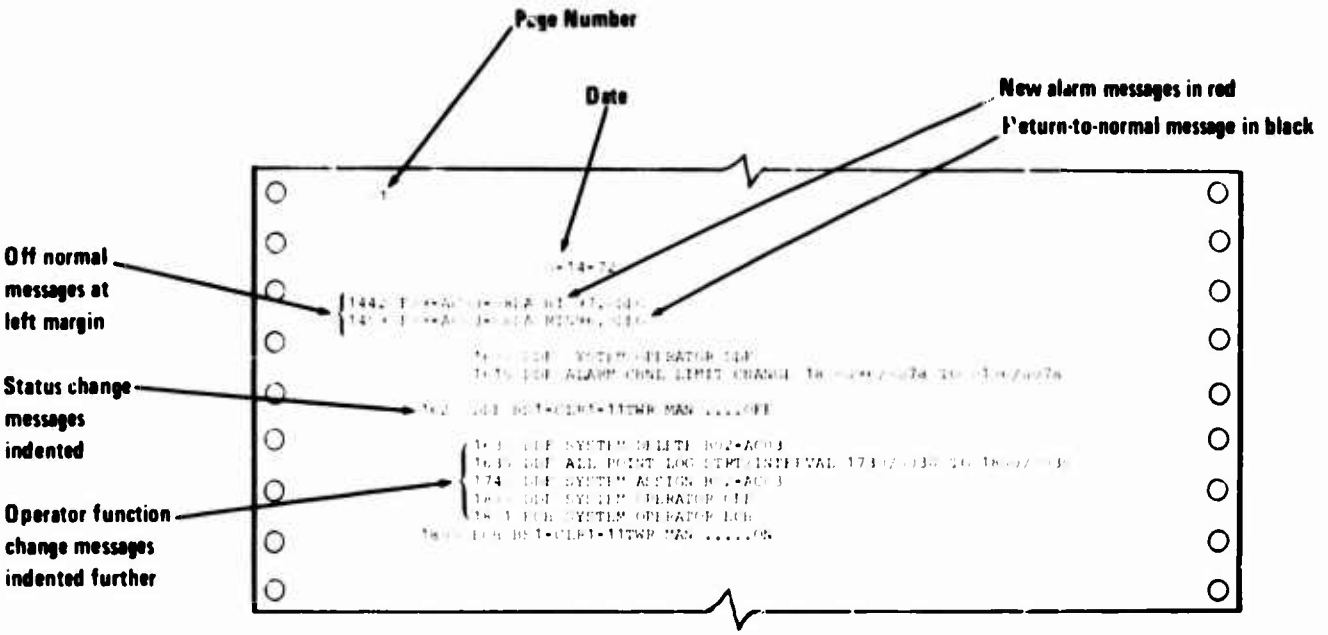
PLANT OPERATIONS

The systems management information media are particularly useful to various levels of plant operation. The operating crew will be able to operate the mechanical systems according to pre-established procedures.

The chief operator can use alarm and status records to smooth out shift changes and to spot trouble. These records also help him relate performance of maintenance to alarm reports.

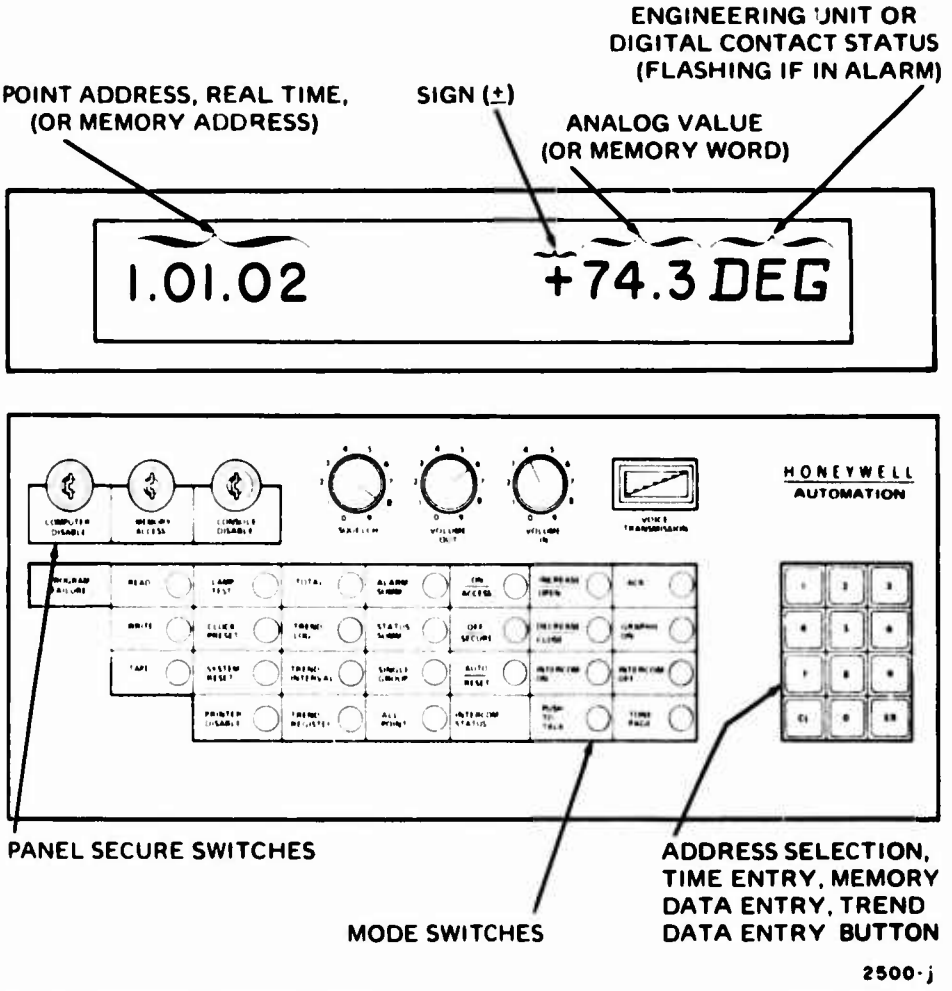
Equipment failure rates and running hours data from alarm and status summaries help the plant superintendent identify needed procedures. Totalizer logs help him evaluate overall plant efficiency, leading to possible changes in operating procedures.

The physical plant director uses computed value logs to evaluate costs, plan operating and maintenance budgets and bill various departments for environmental services. A frequency study of trouble reports based on the alarm summary printout will help him plan manpower needs and preventative maintenance programs.



SYSTEM CHANGE MESSAGES

STARTUP/BACKUP



OPERATOR'S STARTUP/BACKUP CONSOLE ADDRESS AND DATA DISPLAY AND CONTROL AND SELECTION KEYBOARD

OPERATION

During periods of building startup, checkout, or computer servicing, the system may be placed in a backup mode of operation simply by operating a keyswitch labeled COMPUTER DISABLE on the operator's backup console. In this mode all system access is transferred to the backup console which then operates directly through the CPU. The graphics projection module and the single logging printer remain operative. The CRT console, H316 real-time central computer unit, and the separate alarm and message printer are not functional in the backup mode.

CONSOLE ACCESS

For operator's access, the CONSOLE DISABLE switch is used. With this switch *on*, the operator may silence alarms, control remote points, operate the graphics projector, and request printed logs.

SYSTEM FUNCTIONS

The backup mode provides all of the following functions:

Demand Display Functions

1. Operating mode
2. Analog value
3. Alarm summary
4. Status summary
5. Real time

Command Functions

1. Start-stop motor control
2. Start-stop-auto motor control
3. Fast-slow-off motor control
4. Heating-cooling changeover control
5. Occupied-unoccupied changeover control
6. Digital setpoint control
7. Intercommunication

Automatic Functions

1. Analog and Digital Alarm Scanning
2. Start-Stop Programming

Demand Log Functions

1. Alarm Summary
2. Status Summary
3. Single Group
4. All Point
5. Totalizer
6. 6-Point Trend

Selectographic Slide Projector

1. Automatically indexed on system selection
2. Automatically indexed on new alarms

SYSTEM CAPACITY

1. Point capacity same as under computer control
2. 60 analog alarm points
3. 6 start-stop programs, 60 loads
4. Shared, single, alarm and logging printer
5. Shared 81-Frame Selectographic Projector

SPECIFICATIONS

- *GENERAL*

CAPACITY:

Total Points 2000 (typical distribution)
Points per System 30 maximum
Calculation Points 100 maximum
Analog Alarm Limit Channels–55
Start-Stop Programs–55
Expansion Capacity 2/000 points with added channels and memory

ENVIRONMENTAL: +32 to 85F, 95% RH maximum.

POWER REQUIREMENTS:
H316 Real-Time Central Computer Unit–120v, 60 Hz, 30 amp service. (2-1/2 kva isolation transformer required. Topaz, Inc., or equal.)
DELTA Central Processing Unit–120v, 60 Hz, 30 amp service.

TRANSMISSION CABLE: 2-wire coaxial.

SCAN SPEEDS:
Analog 200 points per second.
Digital–1000 points per second.

ALARM ANNUNCIATOR:
New Alarms–Tone signal and red printout on alarm and message printer.
Return-to-Normals–Black printout on alarm and message printer.

INTERCOM: 20-watt transmit amplifier for multistation paging, 4-watt receive amplifier. 300 to 3000 Hz audible voice range. 2-wire, 20-gage, twisted, shielded cable.

- *H316 REAL TIME CENTRAL COMPUTER UNIT*

COMPUTER: H316 stored program, parallel organized, general purpose computer. 16-bit word size, 16,384 words, core-type memory. Real time clock, Automatic restart. I/O bus to DELTA/H316 interface and peripherals interface.

PERIPHERALS INTERFACE: Input-output between H316, two Teletype printers and CRT console.

- *DELTA CENTRAL PROCESSING UNIT*

MAINFRAME: Solid-state scanner for all connected points.

PRINTER INTERFACE: Output to single logging printer in backup mode.

DELTA/H316 INTERFACE: Input-output between DELTA processor and H316 I/O bus.

PROJECTOR INTERFACE: Output to systems graphic projector in backup mode.

PROGRAMMABLE MEMORY: 256-word memory; 60 analog limits; 6 start-stop programs, 60 loads in backup mode.

- *OPERATOR'S CRT CONSOLE*

CRT DISPLAY:
Model–ADDS Consul 880
Type–80-character per line, 24-line CRT terminal. 64-alphanumeric character set with programmed cursor operation.
Displays–"HONEYWELL DELTA 2000", time, date, operator's initials, digital points with program parameters, analog points with high-low limit parameters, system data, new alarm data, alarm summaries, status summaries, and all operator command and program change requests.
Characters–5x7 dot matrix
Display Presentation–dark character on light background
Screen Size–12-inches diagonal
Refresh Rate–60 frames/second
Update Rate–1500 characters/second

OPERATOR'S KEYBOARD: 65 alphanumeric, control, and typewriter format keys: 30 function/action keys; intercom controls.

- *ALARM AND MESSAGE PRINTER*

MODEL: Teletype 35RO page printer, red print for new alarms, black for normal data.

SPEED: 10 characters per second.

FORMATS: New alarms and return to normals at left margin, operator change messages indented to position 9, automatic change messages indented to position 17.

- *LOGGING PRINTER*

MODEL: Teletype 35RO page printer, red print for current alarms, black for normal data.

SPEED: 10 characters per second.

FORMATS: Single system log, alarm summary log, status summary log, all point log, 8-point trend log, start-stop program summary log, single start-stop program summary log.

STARTUP/BACKUP MODE: Single printer outputs new alarms and return-to-normals, alarm summary log, status summary log, all point log, and 6-point trend log.

- *SYSTEM GRAPHIC DISPLAY PROJECTOR*

MODEL: 81-Frame Carousel slide projector.

SPEED: Less than 4-seconds access time.

OPERATION: Indexed automatically by manual selection of system and by new alarm occurrence, both in computer and backup mode.

- *OPERATOR'S STARTUP/BACKUP CONSOLE*

ADDRESS AND DATA DISPLAY:
Type–Single line of eleven tubes.
Format–Five numeric tubes for point address, real time, or memory address; one tube for analog sign (±); three numeric tubes for analog value or memory data; three Nixie tubes for contact status or analog value (flashing if in alarm).

OPERATOR'S KEYBOARD: Three keylock switches for COMPUTER DISABLE, MEMORY ACCESS, CONSOLE DISABLE; 26 illuminated mode and control switches; 10 address selection buttons plus CLEAR and EXECUTE; intercom controls.

- *CONSTRUCTION*

H316 AND CPU CABINETS: White Formica table top, storage shelf. Removable blue (or green) and white panels on all four sides. Black frame and base. Side panels and frame 14-gage steel, base 11-gage steel. Levelers on base.

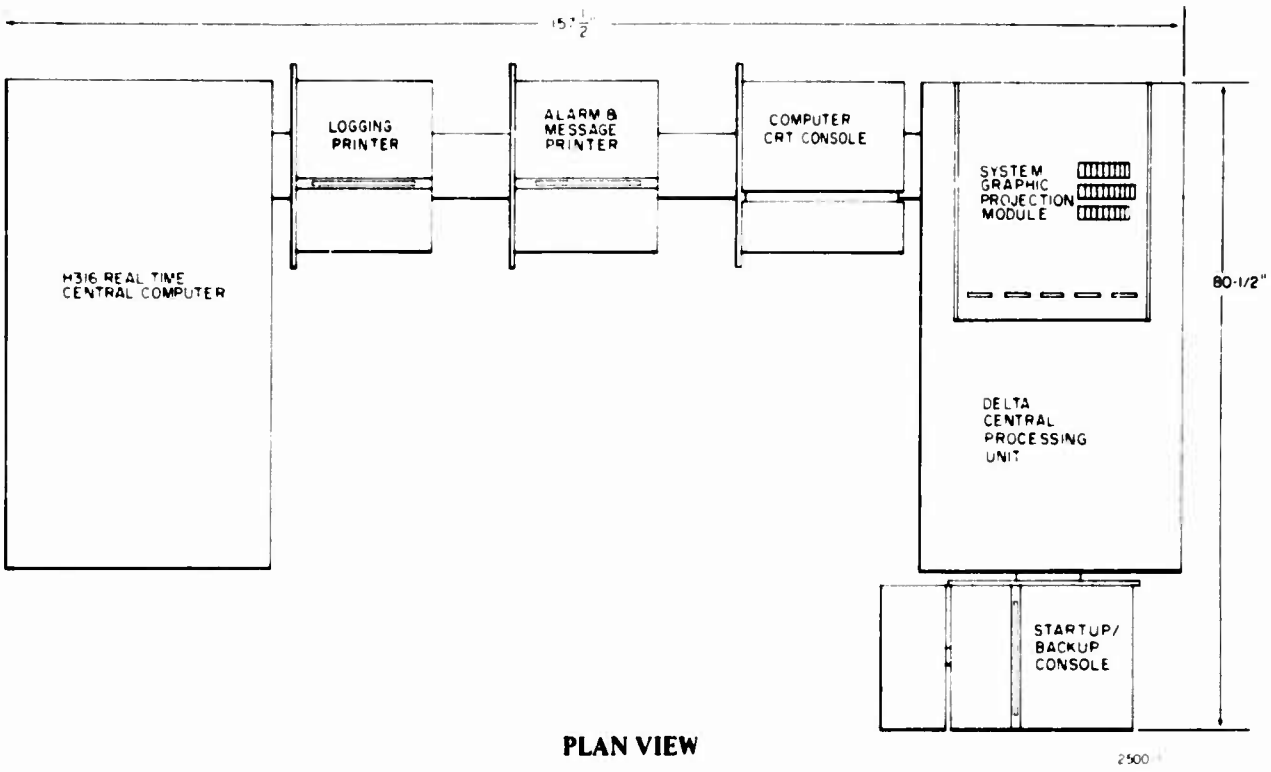
OPERATOR'S CRT PEDESTAL: Designed for standup, sit down operation. Dead-front CRT display screen, sloped keyboard. Removable covers for access to CRT and keyboard. Self contained cable raceway. Upper cover white, lower cover blue (or green), keyboard cover and base black. CRT housing and keyboard cover, aluminum; base 11-gage steel.

OPERATOR'S STARTUP/BACKUP PEDESTAL: Similar in construction to CRT pedestal. Hinged blue (or green) covers, black keyboard and base. Covers 16-gage steel, pedestal-base 11-gage steel.

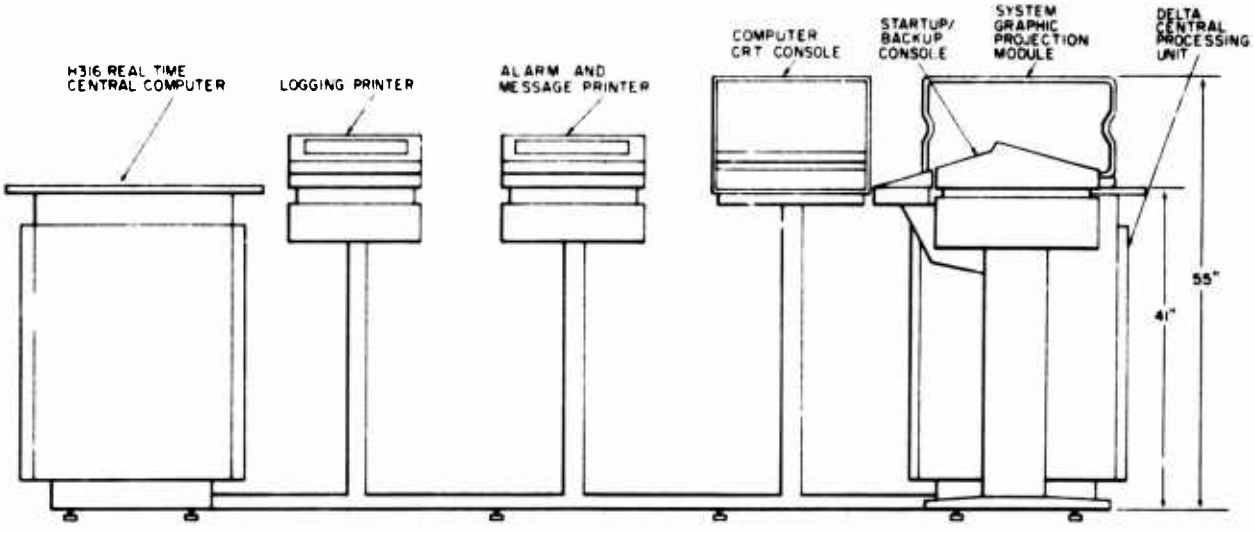
PRINTER PEDESTALS: Similar in construction to backup pedestal except less keyboard assembly.

PROJECTOR HOUSING: Turntable mounting. Hinged top for rapid access to projector.

- ***DIMENSIONS***



PLAN VIEW



FRONT VIEW

(Other physical arrangements are available.)

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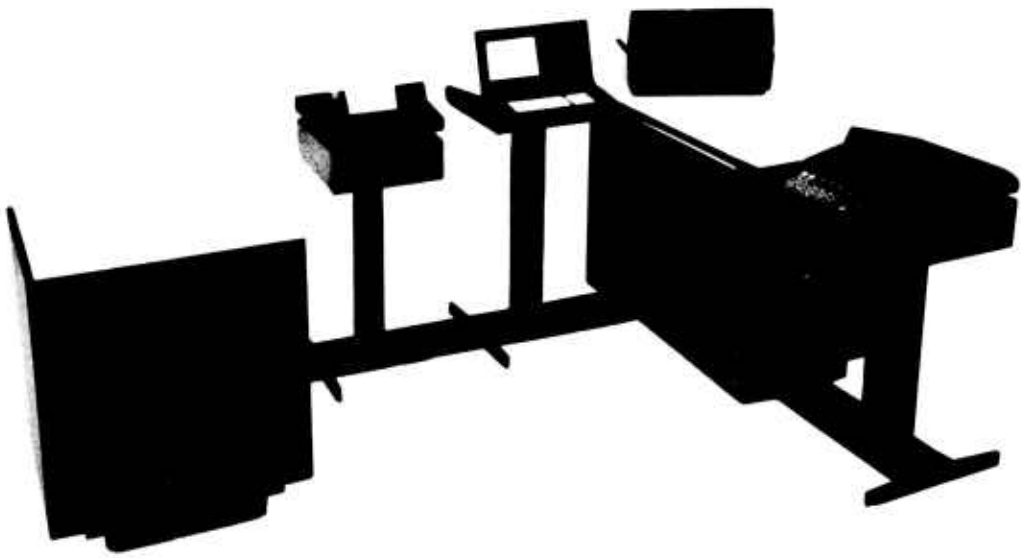
△ SPECIFICATION DATA



DELTA 2000* COMPUTER SYSTEM

*Trademark
Rev. 12-73
D.F.
-01

Honeywell
Commercial Division
FORM NO. 74-1866

CONTENTS

CONTENTS (Continued)

- *27,000 Point Capacity*

Extra channels in the processor can provide communication with as many remote systems as needed. Restriction of H316 usage to calculations, and other routines typically applied to a selected group of inputs and outputs, assure that throughput of the computer will not be impaired regardless of point expansion. Data files where individual points are kept track of can be expanded easily through the use of bulk memory.

- *DELTA Central Processor and Startup/Backup Console Fully Operational When H316 Shut Down*

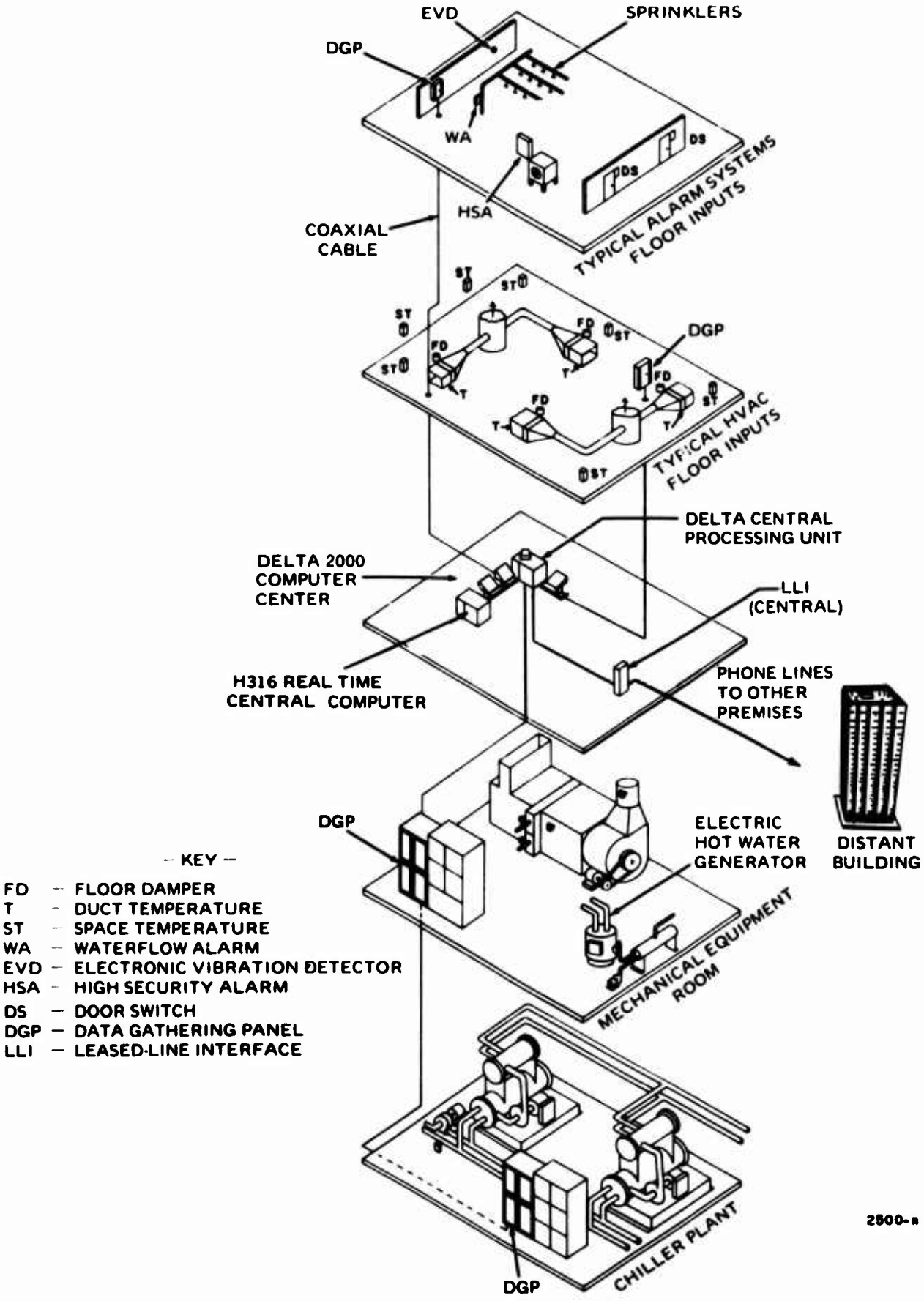
This feature allows addition of new software routines and application packages to the computer without impairing the alarm detecting and manual supervisory control of all connected systems and points. It also allows a complete operational check and verification of every input contact, analog sensor, and output module (such as start-stop) before any computer software or application routines are installed. This makes the software installation easier since all field generated data has already been tested and proved correct. Finally, the DELTA processor can be shipped early and used to operate the building as soon as remote sensors, panels, and coaxial cable is wired up.

- *Energy and Cost Control Application Package Fits Any Central Plant*

This standard, universal, application package is designed to monitor use of energy and dollars used by chillers, boilers, air-conditioning, and lighting systems in any building, whether the energy source is fossil fuel, electricity, or purchased steam. In addition, it permits tracking of energy input to chillers or boilers with energy output in the form of chilled water, hot water, or steam so that managers can set standards of performance and continue to check daily operation against those standards.

- *Standard Software, Standard System Architecture, and Full Documentation with Broad Base of Systems Engineering Skills from Any Honeywell Location*

The DELTA 2000 Computer System is the first in our industry to accomplish a standard set of software and application packages that can universally apply to any building mechanical system. It is also the first system to use the same architecture for all automation needs from the smallest to the largest building installation. And it is the first to provide fully documented software packages including detailed sequence of operation, logic flow charts, program listings, and master punched tapes. This documentation not only lowers the cost of each project, but assures continuity of programming support, independent of the systems analysts or programmers that originally designed the system.



– KEY –

FD – FLOOR DAMPER
T – DUCT TEMPERATURE
ST – SPACE TEMPERATURE
WA – WATERFLOW ALARM
EVD – ELECTRONIC VIBRATION DETECTOR
HSA – HIGH SECURITY ALARM
DS – DOOR SWITCH
DGP – DATA GATHERING PANEL
LLI – LEASED-LINE INTERFACE

DELTA 2000 COMPUTER CONTROL SYSTEM
–SYSTEMS OVERVIEW–

SYSTEM COMPONENTS

DELTA CENTRAL PROCESSING UNIT

The Central Processing Unit (CPU) with its Startup/Backup console described in the following performs the startup and remote data-gathering functions for DELTA 2000 Computer Systems. The CPU contains a high-speed analog and digital scanner which serves as a continuous message center between the remote, data gathering panels and the H316 I/O bus. Basically, the central processor:

- Sequentially interrogates each remote data gathering panel (DGP) and transfers all system and point data to the H316.
- On command from the H316, outputs commands to remote points requested by the operator's keyboard or the internal computer program.

The CPU also contains projector controls and input/output access for Startup/Backup console operation.

STARTUP/BACKUP CONSOLE

During startup, before the H316 real-time central computer is installed, and later during periods when the H316 is turned off, the Startup/Backup (SU/BU) console is used to acknowledge alarms, operate remote start-stop and CPA/DPA modules. Remote intercom stations may also be operated. All operations are via the CPU and remote data gathering panels when the H316 is off. The Startup/Backup console also permits operating the system graphics projector.

H316 REAL TIME CENTRAL COMPUTER

The H316 Real-Time Central Computer (RTCC) unit includes a computer mainframe, core memory, a programmer's panel, a peripherals interface, and provision for a future, bulk memory unit.

Hardware features

General Purpose, parallel access
Automatic restart
16-bit word size
72 instruction complement
1.6μ-sec speed

Software features–

Receives data from CPU and remote points at up to 1000 points per second.
Operates the CRT display and receives keyboard commands.
Controls printout of all alarms, messages, and logs.
Performs all calculations.
Operates on-line control programs via the remote Data Gathering Panels (DGP's).

COMPUTER CRT CONSOLE

ALARM, MESSAGE, AND LOGGING PRINTER

The printer operates on request from the operator's keyboard to output a variety of logs in hardcopy form. Each separate log starts on a new page with the page number printed first, then the log title, time, and date. This is followed by a printout of up to date information provided by the H316. Printout is in black except for points with uncleared alarms. These points in red. The following logs may be requested:

- Alarm Summary
- Status Summary
- Single System
- All Point
- Totals
- Start-Stop Program Summary Time Information
- Start-Stop Program Summary Point Information

The printer also provides automatic printout of messages occurrence of any change in the system. Each message is printed on an individual line and starts at one of three positions across the page, depending on the reason for the change. All printout is in black except new alarm messages. These print in red. The following types of messages printout automatically:

- Alarm change messages
  - New analog or digital alarms
  - Return to normals
- Status change messages
  - Command changes by operator
  - Changes by start-stop program
- Operator change messages
  - Assign/delete system or point
  - Enter new analog alarm limit data
  - Operator sign on or off
  - Other computer access data

EXECUTIVE PROGRAM AND APPLICATION PACKAGES

- *Executive Program* — The executive program is the basic program contained in all DELTA 2000 Computer Systems. This program includes the interrupts, priorities, and basic routines to accomplish data acquisition, outputs, and other periodic functions performed by the computer. The executive program includes:

  - Console keyboard inputs
  - Console CRT formats and display
  - Printer format and control
  - Interface control, H316 to CPU
  - H316 data file
  - Logging and scanning routines
  - Analog limits comparison
  - Priority system for operation of modular application packages

- *Application Packages* — Application packages are a combination of required hardware, including remote inputs and outputs, plus programming of the computer memory to produce the specified results. The application packages vary depending on the items furnished for a particular job. Application packages consist of:

  - Specifications
  - Macro flow charts
  - Operating sequence description
  - Input-output summary
  - Dedicated segment of H316 memory
  - Input sensors
  - Output devices
  - Hardcopy and CRT displays
  - Acceptance procedures

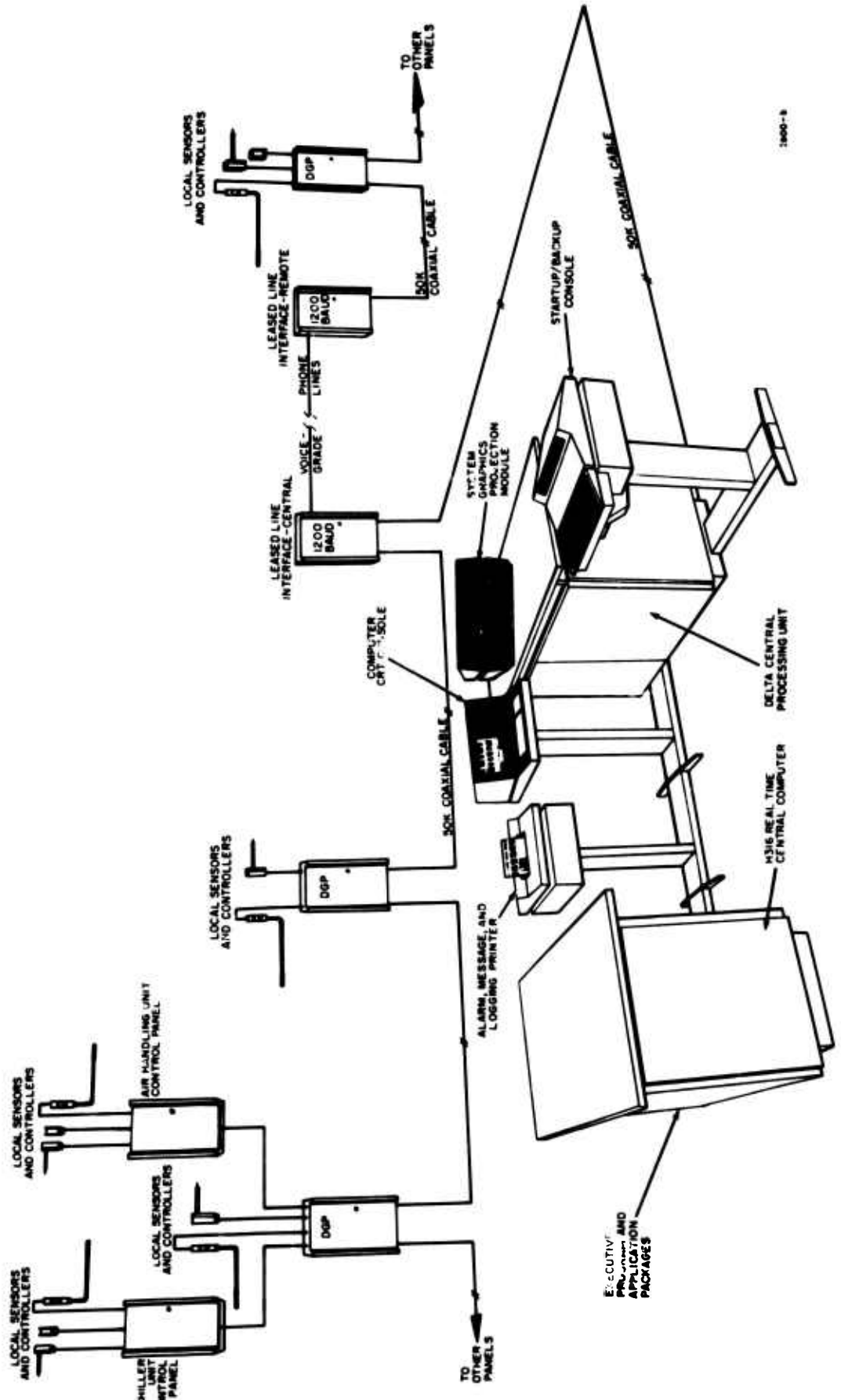
  Typical application packages are:

  - Trend logs
  - System energy profiles
  - Calculation program
  - Automatic start-stop program

SUPPORT SOFTWARE

Support software includes programs used by Honeywell factory and field personnel to program the H316. Support programs consist of:

- Program tapes
- Program listings
- DAP-16 assembler
- DEBUG (permits on-line program changes via the CRT keyboard)
- Patch loader (permits blocks of program changes via punched paper tape)
- 016-XREF Concordance generator
- H316/CPU interface checkout program
- CRT/printer interface checkout program
- Data file generator



DELTA 2000 COMPUTER CONTROL SYSTEM
–SYSTEM COMPONENTS–

MAN-MACHINE INTERFACE

Man-Machine Interface (MMI) is a term used to describe the command and display components used by the console operator to communicate with remote systems and points. These components are:

- Computer/CRT Console
- Alarm and Logging Printer
- Selectographic Projector

The prime function of these components is to present remote system information to the operator quickly, and without need for interpretation, and to permit him to send commands to the remote systems that can be verified before being executed.

With the H316 real-time central computer on line, all man-machine interface is accomplished through the computer CRT console. Typically, single system displays may be obtained furnishing a projected graphic and updated CRT display of current values, a timed-interval log printout, and audio monitoring of the run condition of operating equipment. Individual analog and digital points may be displayed and control functions performed to change the run status of operating equipment or setpoint of local control loops. If personnel are in the remote mechanical equipment room, the intercom may also be used for voice communications. If study or diagnostics is required between systems—say a chiller plant and cooling tower—logs may be requested on a timed interval basis to study data from several systems over a period of time.

While a large variety of functions can be initiated via the CRT console, the following are the more frequently used by the operator:

- Computer/CRT Console Access
- Alarm Reports and Displays
- System Displays
- Single Point Displays
- On-Off Commands
- Control Point Adjust (CPA)
- Intercom with Remote Panels
- Log Printouts

All MMI software is designed so that memory locations are protected from operator errors. Any invalid command results in INVALID appearing blinking on the CRT. In addition hardware failures report as trouble (TBL) if a remote system fails to report to the CPU properly; error (ERR) if a remote point fails to report properly; or data transmission (DXM) if the software detects a hardware failure. Thus the operator is protected from performing invalid operations and from faulty data.

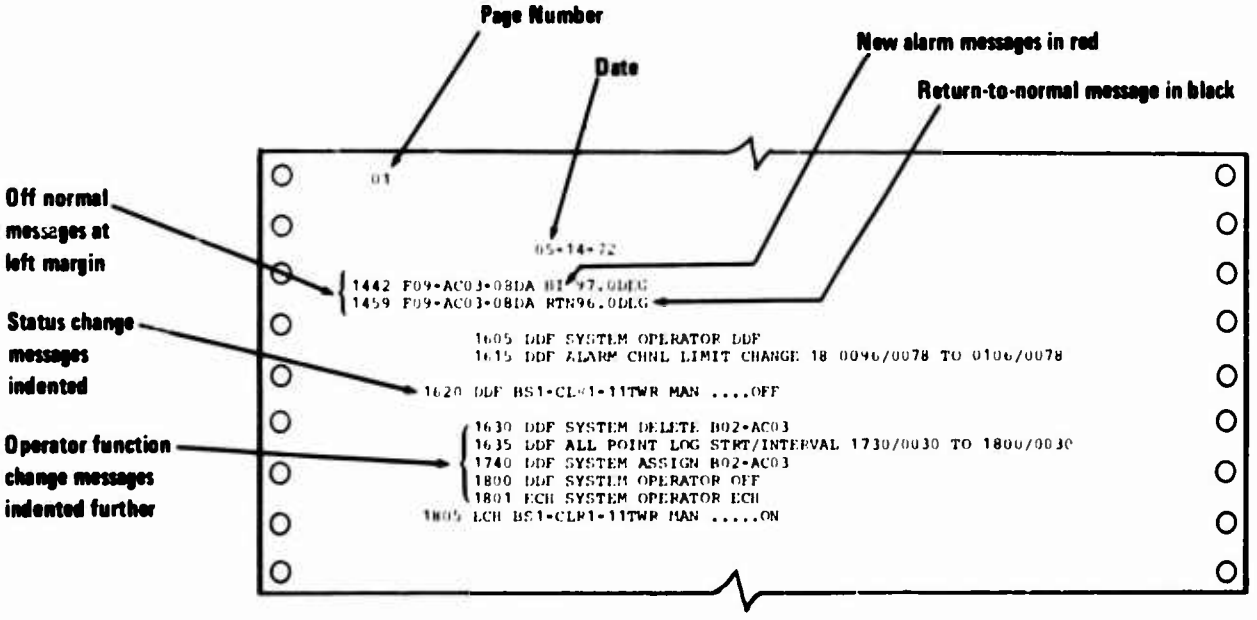
Level 2 Operator's level. Persons at this level may:
Acknowledge alarms.
Operate manual control keys.
Operate display request keys.
Operate log request keys.

Level 3 Supervisor's level. Persons at this level may:
Acknowledge alarms.
Operate manual control keys.
Operate display request keys.
Operate log request keys.
Change parameters, such as, alarm limits, start-stop program times, assign/delete of system and points.
Change operator identification numbers, level, and initials.

Level 4 Programmer's level. Persons at this level may:
Perform Level 3 functions.
Change the internal computer program.

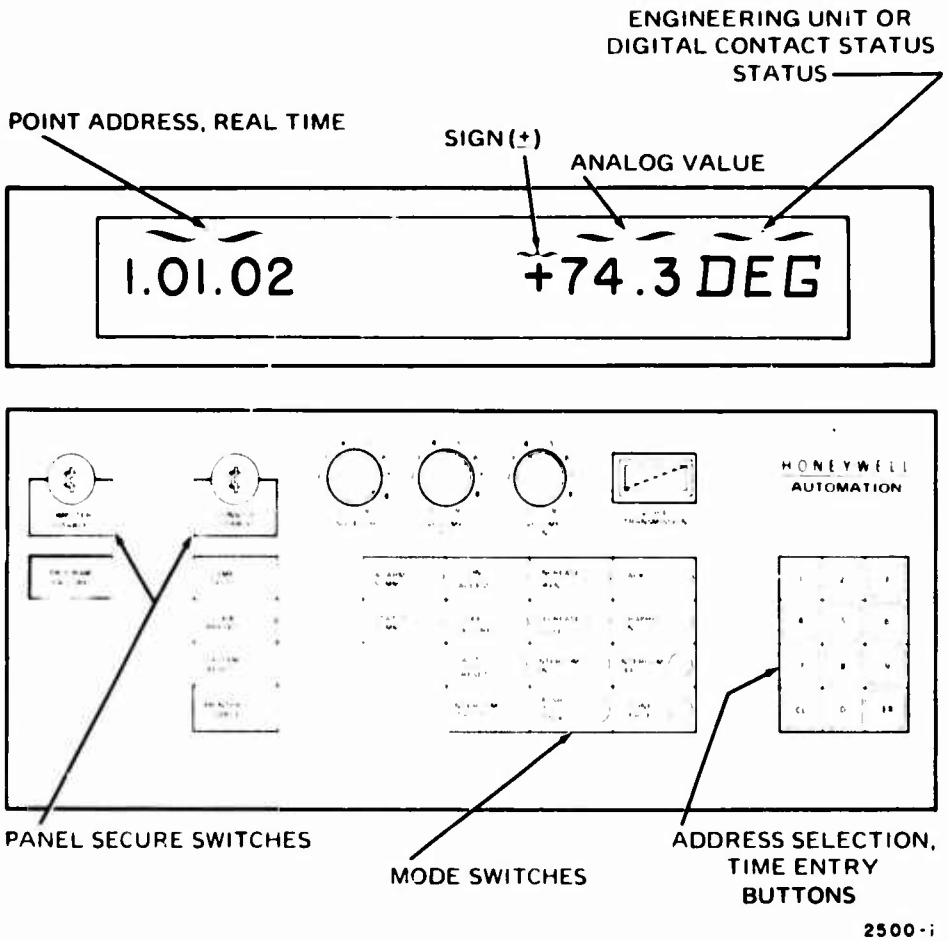
PRINTOUT OF SYSTEM CHANGES

Along with providing display, logging, and control functions, the system is designed to automatically furnish printed messages for all changes that occur whether from off-normal alarms or return to normals (RTN), remote status changes, or operator function changes. Off-normal messages print at the left margin. New alarms are printed in red and return to normals in black. Status-change messages are indented and indicate remote status changes caused by the system operator (MAN), by a start-stop program (AUTO), or by an optimized program (OPT). Operator function changes are indented further and indicate operator-permitted changes in the computer program parameters. These changes include items such as operator sign-in/off, analog alarm channel high/low alarm limit assignments, system-point delete/assign, all-point log start and interval times, and other items necessary for man-machine interface. Thus, a printout is provided of all changes that occur in the system operation.



SYSTEM CHANGE MESSAGES

STARTUP/BACKUP



OPERATOR'S STARTUP/BACKUP CONSOLE ADDRESS AND DATA DISPLAY AND CONTROL AND SELECTION KEYBOARD

OPERATION

During periods of building startup, checkout, or computer servicing, the system may be placed in a backup mode of operation simply by operating a keyswitch labeled **COMPUTER DISABLE** on the operator's backup console. In this mode all system access is transferred to the backup console which then operates directly through the CPU. The graphics projection module remains operative. The CRT console, H316 real-time central computer unit, and the logging printer are not functional in the backup mode.

CONSOLE ACCESS

For operator's access, the **CONSOLE DISABLE** switch is used. With this switch *on*, the operator may silence alarms, control remote points and operate the graphics projector.

SYSTEM FUNCTIONS

The backup mode provides all of the following functions:

Demand Display Functions

1. Operating mode
2. Analog value
3. Alarm summary
4. Status summary
5. Real time

Command Functions

1. Start-stop motor control
2. Start-stop-auto motor control
3. Fast-slow-off motor control
4. Heating-cooling changeover control
5. Occupied-unoccupied changeover control
6. Digital setpoint control
7. Intercommunication

Automatic Functions

Digital Alarm Scanning

Selectographic Slide Projector

1. Automatically indexed on system selection
2. Automatically indexed on new alarms

SYSTEM CAPACITY

1. Point capacity same as under computer control
2. Shared 81-Frame Selectographic Projector

SPECIFICATIONS

- *GENERAL*

CAPACITY
Total Points 500 (typical distribution)
Points per System 30 maximum
Calculation Points 100 maximum
Analog Alarm Limit Channels 55
Start-Stop Programs 55
Expansion Capacity 27000 points with added channels and memory

ENVIRONMENTAL: +32 to 105F, 95% RH maximum

POWER REQUIREMENTS:
H316 Real-Time Central Computer Unit 120v, 60 Hz, 30 amp service. (2-1/2 kva isolation transformer required. Topaz, Inc., or equal.)
DELTA Central Processing Unit 120v, 60 Hz, 30 amp service.

TRANSMISSION CABLE: 2-wire coaxial

SCAN SPEEDS:
Analog 200 points per second
Digital 1000 points per second

ALARM ANNUNCIATOR
New Alarms Tone signal and red printout on alarm and message printer.
Return-to-Normals Black printout on alarm and message printer.

INTERCOM: 20-watt transmit amplifier for multistation paging, 4-watt receive amplifier. 300 to 3000 Hz audible voice range. 2-wire, 20-gage, twisted, shielded cable.

- *H316 REAL TIME CENTRAL COMPUTER UNIT*

COMPUTER: H316 stored program, parallel organized, general purpose computer. 16-bit word size, 8192 words, core-type memory. Real time clock, Automatic restart I/O bus to DELTA/H316 interface and peripherals interface.

PERIPHERALS INTERFACE: Input-output between H316, two Teletype printers and CRT console.

- *DELTA CENTRAL PROCESSING UNIT*

MAINFRAME: Solid-state scanner for all connected points.

PROJECTOR INTERFACE: Output to systems graphic projector in backup mode.

DELTA/H316 INTERFACE: Input-output between DELTA processor and H316 I/O bus.

- *OPERATOR'S CRT CONSOLE*

CRT DISPLAY:
Model ADDS Consul 880
Type 80-character per line, 24-line CRT terminal. 64-alphanumeric character set with programmed cursor operation.
Displays "HONEYWELL DELTA 2000", time, date, operator's initials, digital points with program parameters, analog points with high-low limit parameters, system data, new alarm data, alarm summaries, status summaries, and all operator command and program change requests.

Characters 5x7 dot matrix
Display Presentation dark character on light background
Screen Size 12-inches diagonal
Refresh Rate 60 frames/second
Update Rate 1500 characters/second

OPERATOR'S KEYBOARD: 65 alphanumeric, control, and typewriter format keys; 30 function/action keys; intercom controls.

- *ALARM, MESSAGE, AND LOGGING PRINTER*

MODEL: Teletype 35RO page printer, red print for alarms; black for normal data.

SPEED: 10 characters per second.

LOG FORMATS: Single system log, alarm summary log, status summary log, all point log, start-stop program summary log, single start-stop program summary log.

ALARM AND MESSAGE FORMATS: New alarms and return to normals at left margin, operator change messages indented to position 9, automatic change messages indented to position 17.

- *SYSTEM GRAPHIC DISPLAY PROJECTOR*

MODEL: 81-Frame Carousel slide projector.

SPEED: Less than 4-seconds access time.

OPERATION: Indexed automatically by manual selection of system and by new alarm occurrence, both in computer and backup mode.

- *OPERATOR'S STARTUP/BACKUP CONSOLE*

ADDRESS AND DATA DISPLAY:
Type Single line of eleven "nixie" and numeric character lights.
Format Five numeric tubes for point address, real time, or memory address; one tube for analog sign (+); three numeric tubes for analog value; three "nixie" tubes for contact status or analog value (flashing if in alarm).

OPERATOR'S KEYBOARD: Three keylock switches for COMPUTER DISABLE, MEMORY ACCESS, CONSOLE DISABLE; 26 illuminated mode and control switches; 10 address selection buttons plus CLEAR and EXECUTE; intercom controls.

- *CONSTRUCTION*

H316 AND CPU CABINETS: White Formica table top, storage shelf. Removable blue (or green) and white panels on all four sides. Black frame and base. Side panels and frame 14-gage steel, base 11-gage steel. Levelers on base.

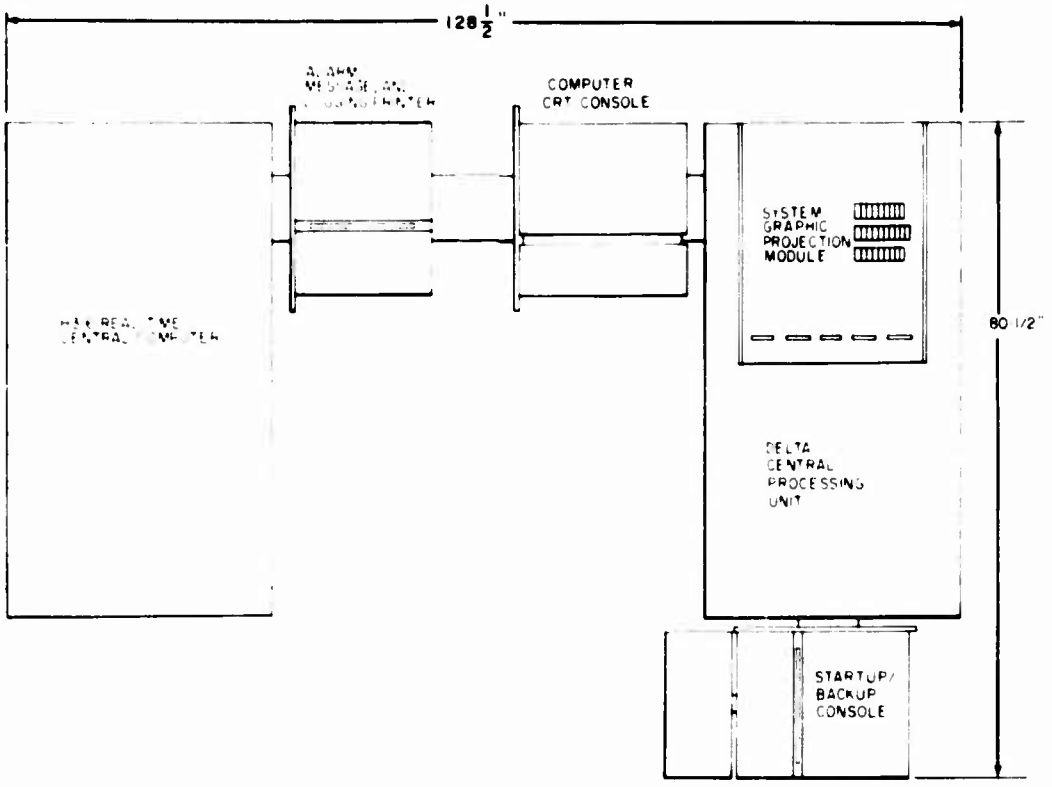
OPERATOR'S CRT PEDESTAL: Designed for standup, sit down operation. Dead-front CRT display screen, sloped keyboard. Removable covers for access to CRT and keyboard. Self contained cable raceway. Upper cover white, lower cover blue (or green), keyboard cover and base black. CRT housing and keyboard cover, aluminum; base 11-gage steel.

OPERATOR'S STARTUP/BACKUP PEDESTAL: Similar in construction to CRT pedestal. Hinged blue covers (or green), black keyboard and base. Covers 16-gage steel, pedestal-base 11-gage steel.

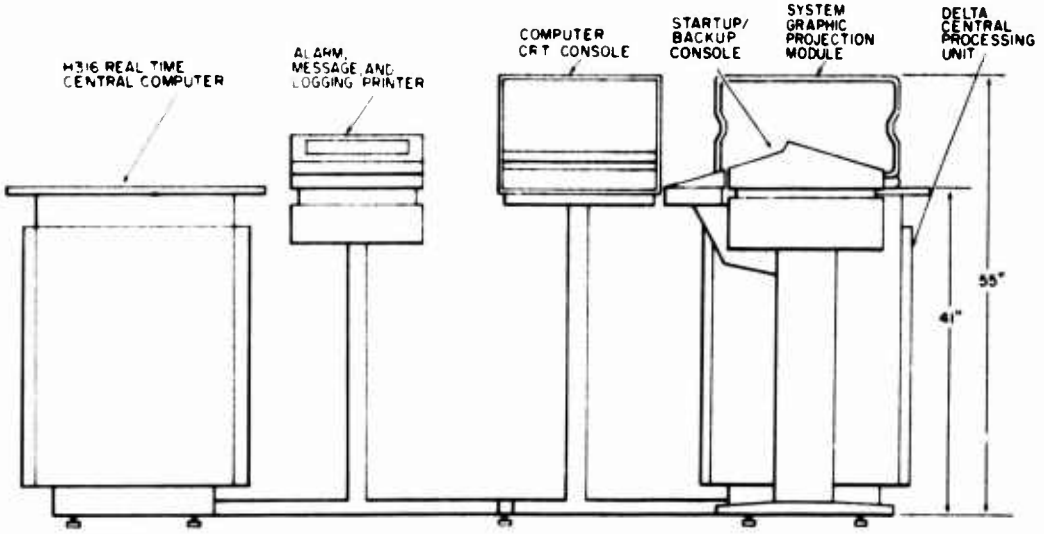
PRINTER PEDESTAL: Similar in construction to backup pedestal except less keyboard assembly.

PROJECTOR HOUSING: Turntable mounting. Hinged top for rapid access to projector.

• *DIMENSIONS*



PLAN VIEW



FRONT VIEW
(Other physical arrangements are available.)

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POWERS AUTOMATION SYSTEM

System 5 Operating Console

APPLICATION

The Operating Console forms the communications link between the operator and the building automation system. It contains the information displays and command buttons for monitoring and controlling the automation system.

CONSTRUCTION

The console consists of a steel desk on which are mounted a hood assembly and a CRT unit with keyboard. The desk has two drawers and is light blue with brushed chrome trim.

The CRT with its associated keyboard is the operator's prime means of communication with the system and provides English language descriptions in its displays.

The hood contains the projector system (if used), the intercom (if used), and certain push-buttons and pilot lights.

CONTROLS

All accessing and commanding is done through the CRT keyboard. The operator can perform the following functions

a. Motor Start-stop

b. Mode [illegible] (heating, cooling, day, night [illegible])

c. [illegible] or valve position or controller [illegible] range

d. Indication of analog values and equipment status

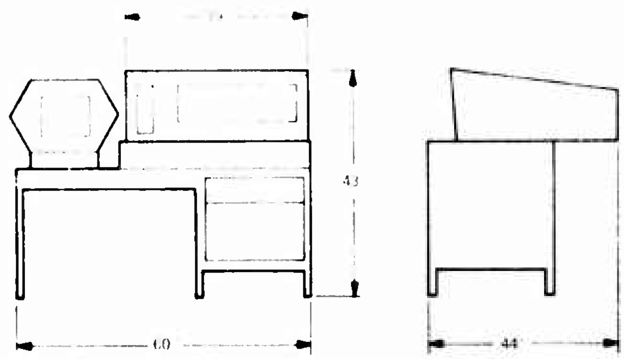
e. Request [illegible] system status, alarm, and trend log

f. [illegible]

g. [illegible] selection

The [illegible] are [illegible] knobs, and the [illegible] pushbuttons and/or pilot lights. The Projector On-Off and Projector Sync buttons are located on the hood under the projector screen as are the Supervisor On-Off and Point Command Enable/Disable Keylocks. Clustered to the lower left of the projection screen are the Console AC, Equipment DC, and Alarm Horn Indicate Pilot lights, and the Horn Enable/Disable pushbutton.

DIMENSIONS



OPTIONS

The following optional equipment is available on the console

a. Slide Projector – The Console is available with one or two 35mm slide projectors depending on the quantity of slides used. The slides are color graphic schematics of building systems. The projectors are each capable of handling up to 80 slides which are automatically projected when the appropriate area/system is accessed by the operator.

b. Intercom – An integral-matrix intercom for voice communication to and from remote locations is available. The intercom is connected for automatic monitoring whenever an equipment system is accessed.

c. Manual-Stand-by Panel – A special control panel is available in the upper desk drawer for manual control of the automation system during maintenance or servicing of the computer or peripheral devices. This panel is also used during System startup before the Central Processing Unit is operational. It incorporates a separate DC power supply operating from building power.

SUBJECT AC 570-1.2
OCTOBER 1971

POWERS AUTOMATION SYSTEM

System 5 Central Processing Unit

APPLICATION

The CPU (Central Processing Unit) of System 5 directs, scans, and accepts requests for the monitoring and commanding of any or all field points and systems. This processing is accomplished by the digital computer, input/output interfaces, and analog to-digital converter. The computer memory stores analog alarm limits, start-stop program sequencing data and information about each point for analysis and English language printout.

DESCRIPTION

General

The Central Processing Unit consisting of power supplies, digital computer, A/D (analog to-digital converter), input/output interfaces, trunk fuse panel and cold junction reference are contained in Powers control cabinets. One or two cabinets are provided depending upon system configuration. The cabinets are free standing with full length rear doors for easy access to components. The doors have a Key-to-Open handle to prevent unauthorized personnel from gaining access to the processing equipment. The control cabinets and doors are constructed of steel and painted computer blue.

MAJOR COMPONENTS AND SPECIFICATIONS

Nova 1200 general purposes digital computer

Specifications

a. MSI circuitry
b. Ferrite core memory
c. 16 bit word length
d. 1.2 microsecond memory cycle time
e. Expansion to 32K of core memory
f. Expansion to 256K of fixed head disk
g. Printed circuit computer and interface boards
h. Hardware multiply divide
i. External I/O bus connector
j. Power monitor and auto restart
k. Real time clock

Vidar 521 analog to-digital converter

Specifications

a. Integrating type
b. Overload protection (150 VAC max.)
c. Error detection sensing
d. Input Impedance 1000 megohms
e. Common-mode rejection

Analog Input Multiplexer

Trunk fuse panel

Intercom amplifier

Power supplies

5 VDC & 24 VDC for CPU and Console

5 VDC & 24 VDC for Manual Stand-By Panel

Cold junction reference

INSTALLATION

The CPU cabinet should be located so the front and rear doors are unobstructed to allow access to the CPU components.

The CPU must be supplied with a 115/120 VAC at 60 ± 0.45 Hz, 1600 (approx.) watt power source.

POWERS AUTOMATION SYSTEM

System 5 Cathode Ray Tube & Input Keyboard

APPLICATION

The CRT (cathode ray tube) terminal with alpha-numeric Input Keyboard and command pushbutton array provides the means to monitor and command Automation System 5.

DESCRIPTION

General

The CRT uses MOS (metal oxide semiconductor) circuitry and features automatic roll-up on the last line. The CRT operates with ASCII (American Standard Code for Information Interchange) code and displays 64 standard ASCII characters using a 5 x 7 dot matrix.

The Input Keyboard and command pushbutton array are an important part of the CRT as they provide operator communication with the system.

The command pushbuttons are colored for ease of operator identification. The covers of the CRT and Keyboard are blue. The screen of the CRT and keys of the keyboard are black.

The CRT screen displays 20 data lines. Five permanently predetermined screen areas are used for specific output data.

At the right of the CRT screen are 16 pilot lights for continuous display of important operator information such as power on, computer mode, supervisor mode, field power fail, etc.

Controls

The 4-row Input Keyboard is similar to an office typewriter. The command pushbutton array at the right of the keyboard contains the following commonly required functions.

a. Horn Silence
b. Display Cancel
c. Log Cancel
d. System Log
e. On-Off–Auto (Htg.-Clg.)
f. Raise-Lower
g. Slow-Fast
h. Alarm Summary
i. Point Execute
j. Area-System Address
k. Point Address
l. Function Code
m. Status Summary
n. All Point Log
o. Alarm Display Acknowledge
p. Entry Cancel

SPECIFICATIONS

Display Capacity	1,000 characters, 50 characters per line, 20 lines
Transfer rates	120 characters per second
Data-panel	16 pilot lights with status legends located on right hand portion of CRT screen
Input Keyboard	Alpha-numeric
Power	115VAC, 60Hz, 105 watts
Weight	50 lbs.
Ambient Temperature Range	50°F –104°F
Ambient Humidity Range	5 – 85% RH
Dimensions	See Figure on Page 2

OPERATION

Functional operations of the CRT include:

a. Continuous display on line one of calendar date, time, and outdoor air conditions.

b. Operator's communication (inputs) with the system on line two. Line two is the only line where the cursor (flashing symbol) is used. The cursor shows the operator where the next alpha numeric symbol from the Input Keyboard should appear.

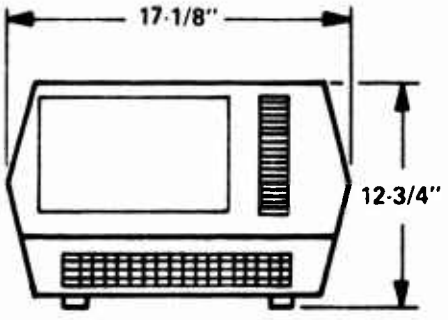
c. Current system activity display on lines 14 and 15.

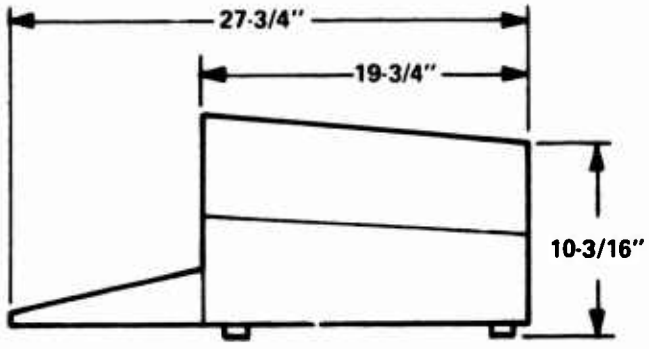
d. Automatic redundant display of critical alarms on lines 17 through 20.

e. Display of single-point data and single system data (up to 20 points of any type simultaneously) on lines 3 through 13.

INSTALLATION

The CRT and Input Keyboard (including the command pushbutton array) sit on the console desk to the (operator's) left of the hood. A 115VAC±10%, 60Hz., 105 watt power source is required.



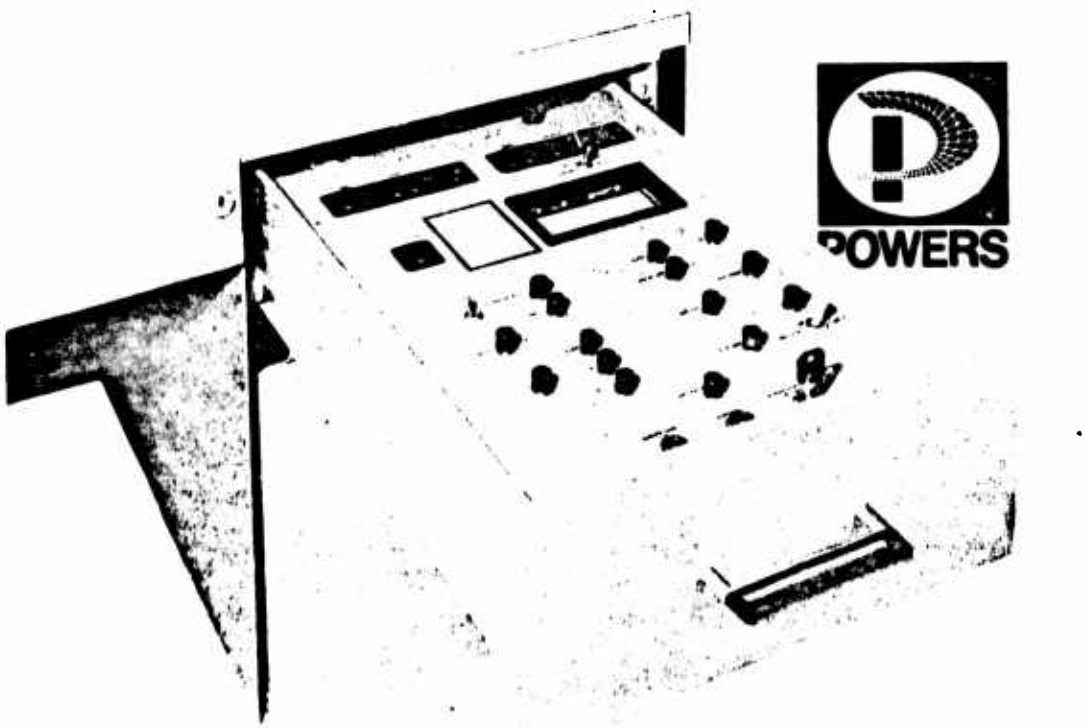


POWERS AUTOMATION SYSTEM

System 5 Manual Standby Panel

APPLICATION

The POWERS Manual Standby Panel is used during the initial start-up of System 5 before the Central Processing Unit is operational. Thereafter it is used as a back-up for manual control of the Automation System during computer maintenance or servicing. It incorporates a separate DC power supply operating from building power.



DESCRIPTION

Construction

The manual standby panel consists primarily of electrical components and associated wiring mounted on a metal panel. The panel, with all necessary controls, switches, and indicators, is mounted in the top drawer of the desk and is painted light blue to match the desk.

Controls

The manual standby panel is completely independent of the CPU (Central Processing Unit). The operator can perform the following functions:

a. Command equipment (motors, modes, CPA).
b. Operate the intercom and projector.
c. Manually search for alarms.
d. Check status of equipment.
e. Read voltages and convert to analog values such as temperature, humidity, damper position, etc.

INSTALLATION

The manual standby panel is mounted in the top desk drawer. Cables, connecting the panel to the trunk fuse panel, are led through a cutout in the back of the drawer.

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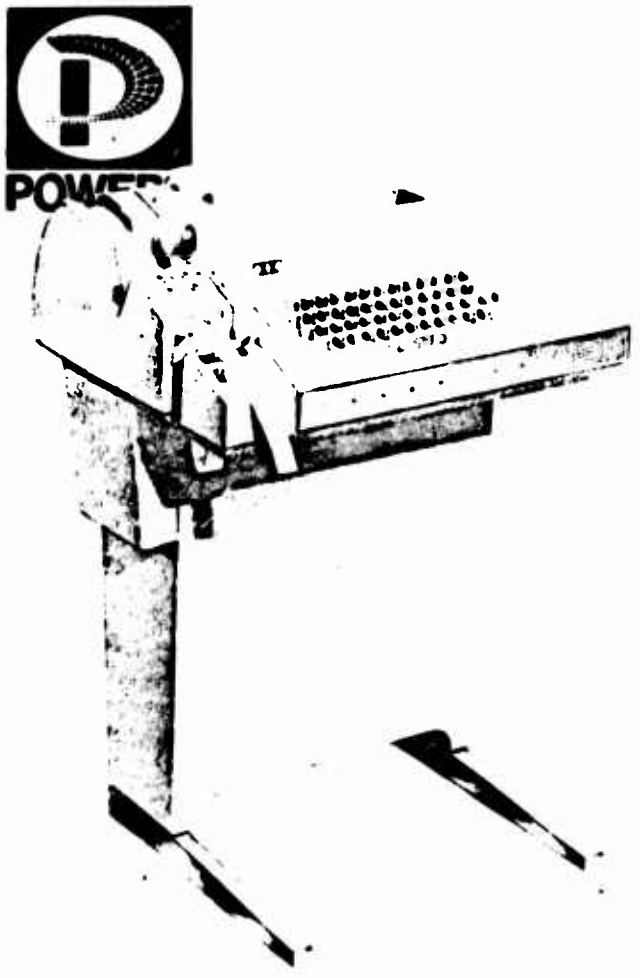
POWERS AUTOMATION SYSTEM

System 5 Alarm Printer

APPLICATION

Teletype Model ASR 33 (automatic send-receive) printer provides automatic reporting (logging) of "single point alarm" and "return to normal" states.



DESCRIPTION

Construction

The alarm printer is supported by a metal stand at a convenient operating height. A cover [illegible] the typing unit.

Major Components and Functions

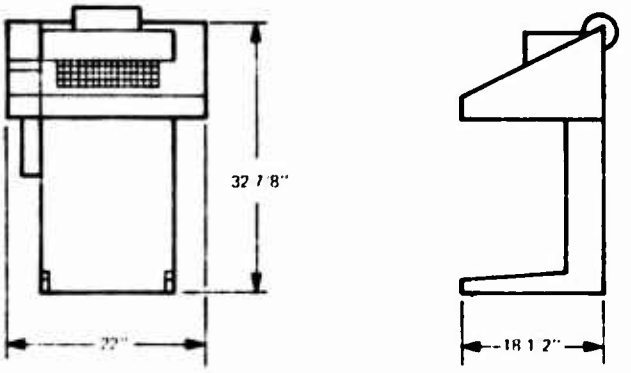
a. Typing unit ..... [illegible] component
b. Keyboard ..... [illegible] component
c. Tape punch ..... perforates holes in tape
d. Tape reader ..... reads (senses) holes in tape
e. Call control ..... electrically joins printer to computer interface

Controls

The 4 row keyboard is similar to an office typewriter. Controls are provided for punch and reader operation. A selector switch controls "LINE-OFF-LOCAL" operation.

SPECIFICATIONS

Speed ..... 10 characters per second
Code ..... ASCII (American Standard Code for Information Interchange)
Characters per horizontal inch ..... Ten
Characters per line 72
Printout ..... Black
Paper roll ..... 4-1/2 inches outside dia. (1" dia. core) x 8-7/16 inches wide x 310 ft. long. White std 1 ply
Tape ..... 1-inch wide oiled paper; 8 level
Dimensions ..... See Figure
Weight ..... 56 lbs. (including stand)
Ambient Temperature range ..... 40 – 110°F
Humidity ..... 95% max.



INSTALLATION

A 115VAC ± 10% 60Hz ± 0.45 Hz, 110 watt power source is required. A nine-pin connector plugs into the appropriate interface.

SUBMITTAL SHEET
AC 570-1.6
OCTOBER, 1971

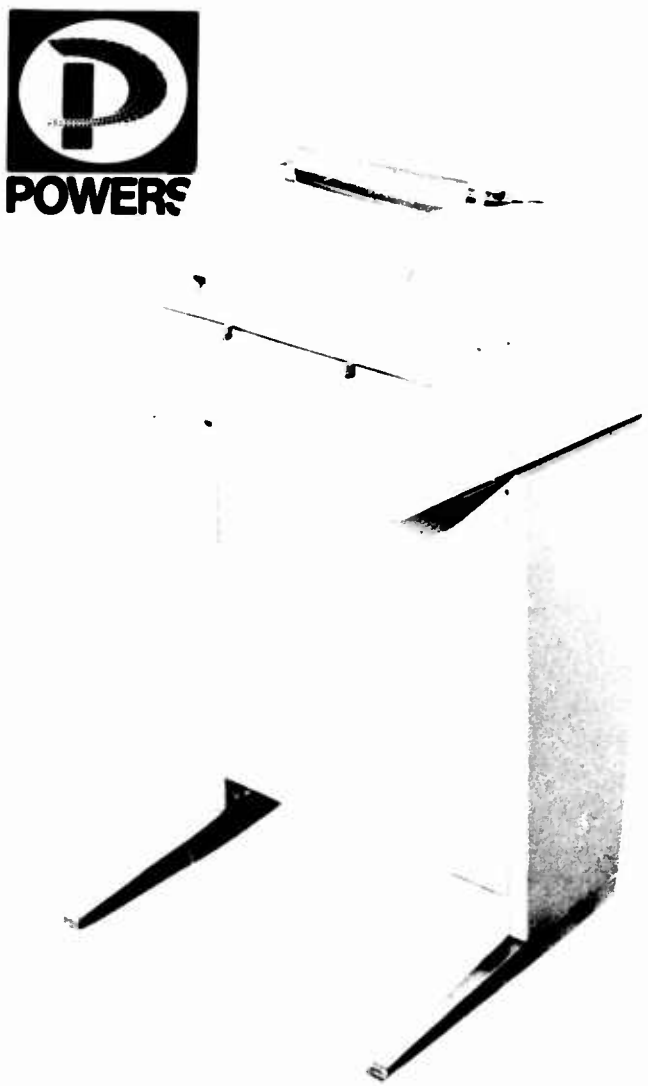
POWERS AUTOMATION SYSTEM

System 5 Data Printer

APPLICATION

Teletype Model RO35 (receive only) printer provides at operator request the following data with points in alarm printed in red.

a. Alarm summary
b. Status summary
c. System log
d. Trend point log (six points maximum)
e. All point log
f. Trend system log



DESCRIPTION

Construction

The data printer is supported by a metal stand at a convenient operating height. An upper hinged cover and a lower cover enclose the typing unit.

Major Components and Functions

a. Typing Unit – receive component
b. Call Control – electrically joins printer to computer interface.

SPECIFICATIONS

Speed ..... 10 characters per second

Code ..... ASCII (American Standard Code for Information Interchange)

Characters per horizontal inch ..... Ten

Characters per line 72

Pin feed platen

Paper roll ..... 4-1/2" outside diameter (1" diameter core) x 8-7/16 inch wide x 310 feet long white std. 1 ply

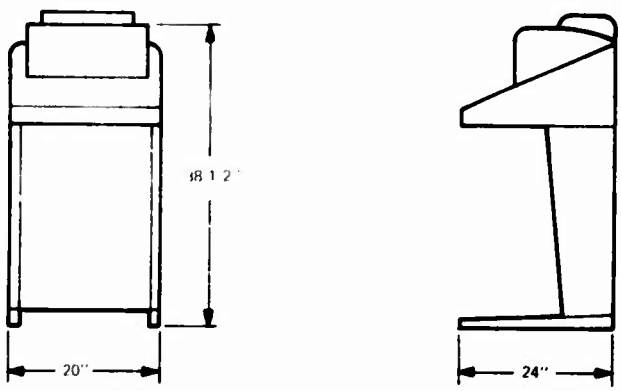
Ribbon colors ..... Black, red

Dimensions ..... See Figure

Weight ..... 130 lbs. (including stand)

Ambient temperature range ..... 40°F – 100°F

Humidity ..... 95% max.



INSTALLATION

A 115VAC ±10%, 60Hz ±0.45, 110 watt power source is required. A nine pin connector plugs into the appropriate interface.

1524

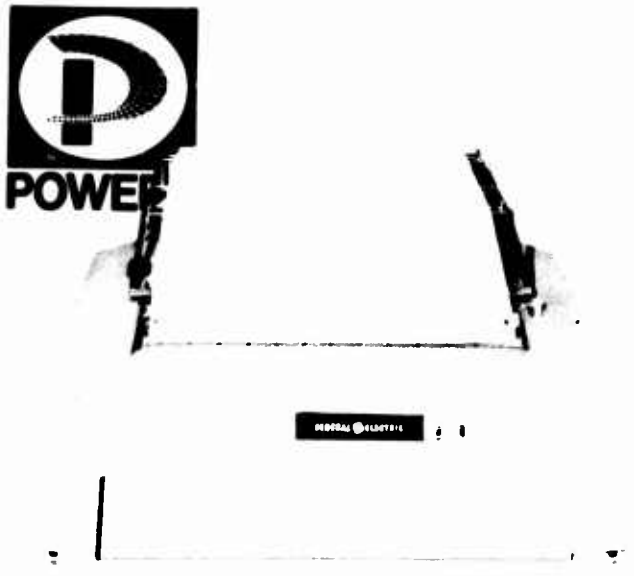
POWERS AUTOMATION SYSTEM

System 5 Data Printer

APPLICATION

General Electric Terminet 300 Data Communication Printer RO (receive only) provides at operator request the following data

a. Alarm summary
b. Status summary
c. System log
d. Trend point (six points)
e. All point log
f. Trend system log



DESCRIPTION

Construction

The Terminet RO Printer is desk mounted. Upper and lower gray covers enclose the print mechanism and electronic logic module.

Major Components and Functions

a. Print mechanism ..... printing
b. Electronic logic module ..... contains printed circuit assemblies

Controls

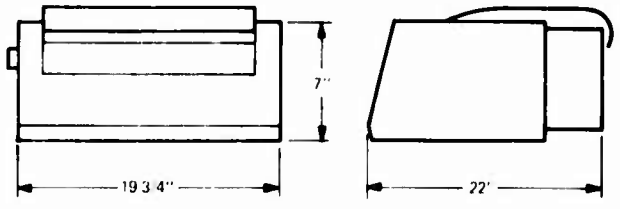
The operator's control panel consists of six illuminated pushbutton switches mounted on the front of the printer. The switches and their functions are:

a. MOTOR OFF ... Disconnects AC when pressed
b. MOTOR ON ..... Connects AC when pressed
c. ALARM ..... Indicates alarm condition
d. LINE FEED .... Advances paper when pressed
e. INTERRUPT ..... Indicates "line break"
f. FORM FEED ..... Advances paper to predetermined line position when pressed

A POWER ON-OFF switch located at the right rear of the printer turns power on to the printer.

SPECIFICATIONS

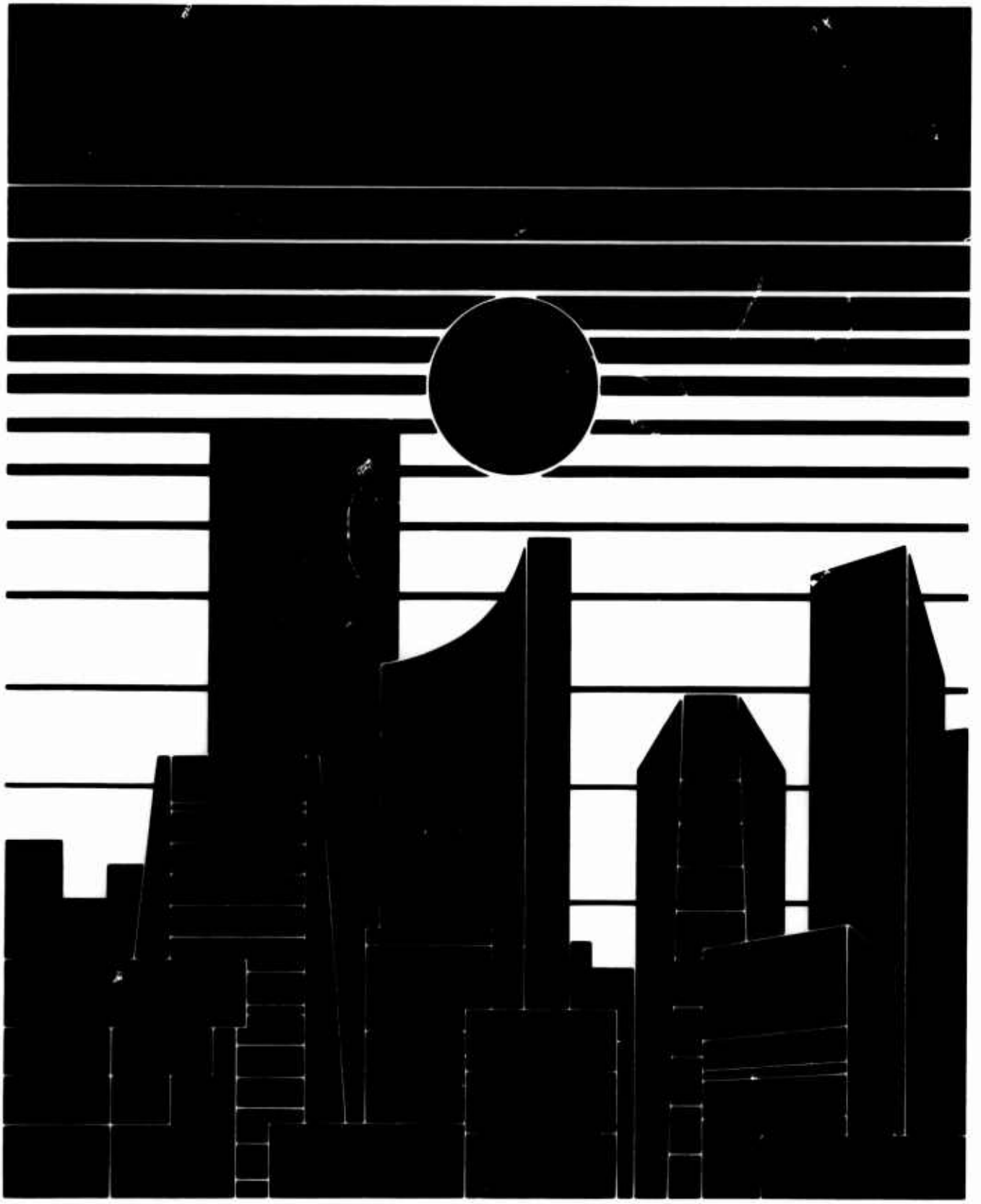
Speed ..... 10, 15, and 30 characters per second
Code ..... ASCII (American Standard Code for Information Interchange)
Characters per horizontal inch ..... Ten
Characters per line 118
Printout ..... Black
Pin feed platen
Pin feed paper ..... 12.85 inch wide fan-fold sheets (contained in 11-inch high box)
Upper case
Form feed (start new sheet)
Vertical tab (for use with pre-printed forms)
Ambient temperature range ..... 32°F – 110°F
Humidity ..... 10% – 95%
Weight ..... 65 lbs.
Dimensions ..... See Figure

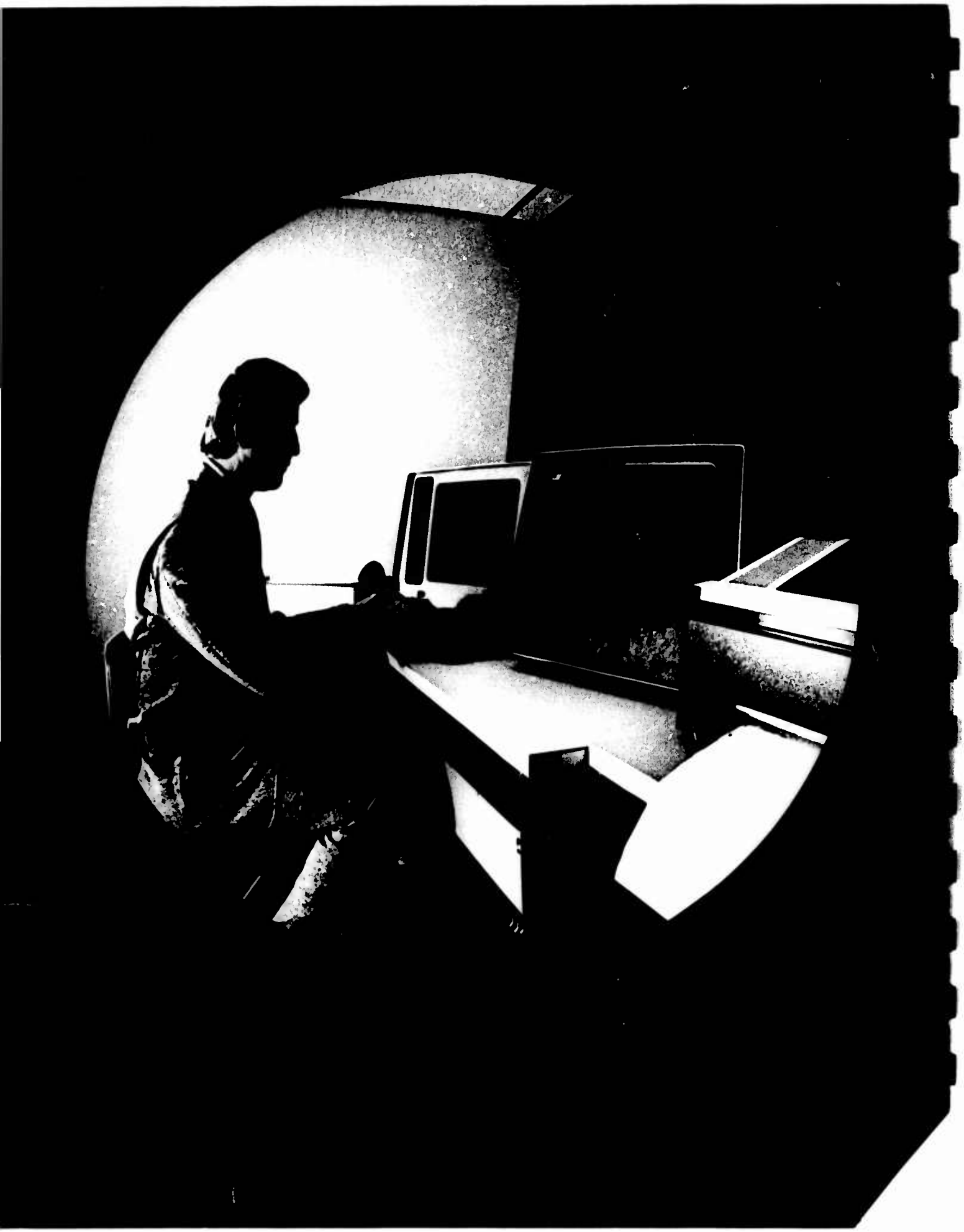


INSTALLATION

A 120 VAC, 60 Hz, 120 watts power source is required. A 25-pin cable connector plugs into the appropriate interface.

JC/80 COMPUTERIZED BUILDING AUTOMATION





JC/80 a system for all buildings

JC/80 building automation systems incorporate the first mini-computer designed specifically for building automation. They provide the ultimate comfort available from a given heating, air conditioning, ventilating system. Their capabilities in both fire and security detection and control are unsurpassed. Communicating over easily-installed coaxial cable, they interface with every type of control system.

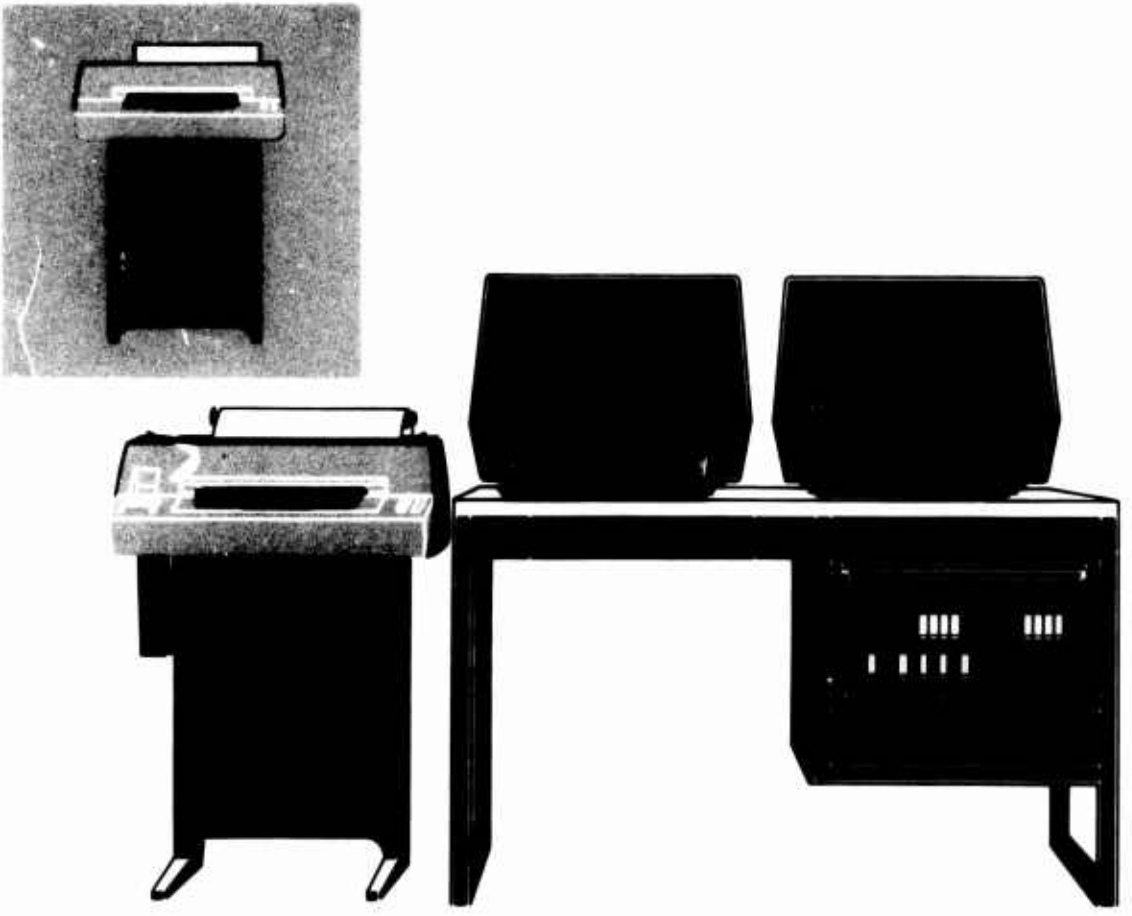
JC/80 building automation systems reduce life cycle costs. They optimize mechanical equipment usage, thus prolonging equipment life, cutting replacement and maintenance costs. Run time can be programmed to conserve energy and optimize its usage. JC/80 systems can be so designed that they simultaneously provide building maintenance programs for more efficient use of manpower. By sensing and controlling electrical loads throughout a building, they can employ electrical power most advantageously relative to use-priorities and power rates. A program can be provided to limit excessive loads to avoid demand penalties.

JC/80 systems can start small and be expanded, changed or re-programmed to match growth or changing needs. Operating at true computer speeds, they can communicate over any distance on leased telephone lines. And they do not slow down with size. They combine double transmission with one of the computer industry's most widely accepted error detecting techniques to provide the highest possible accuracy and reliability.

JC/80 systems can consist of only the mini-computer and one numerically coded input-output device. Typically used in the smaller or lower budget building, such configurations are also used as back-ups for larger, complex systems.

At the other end are very sophisticated JC/80 central systems to provide more extensive processing of data, or to integrate complex multi-system networks. And we cover everything in between.

Flexibility is the keynote



Different sizes and types of buildings require different automation techniques and levels of sophistication.

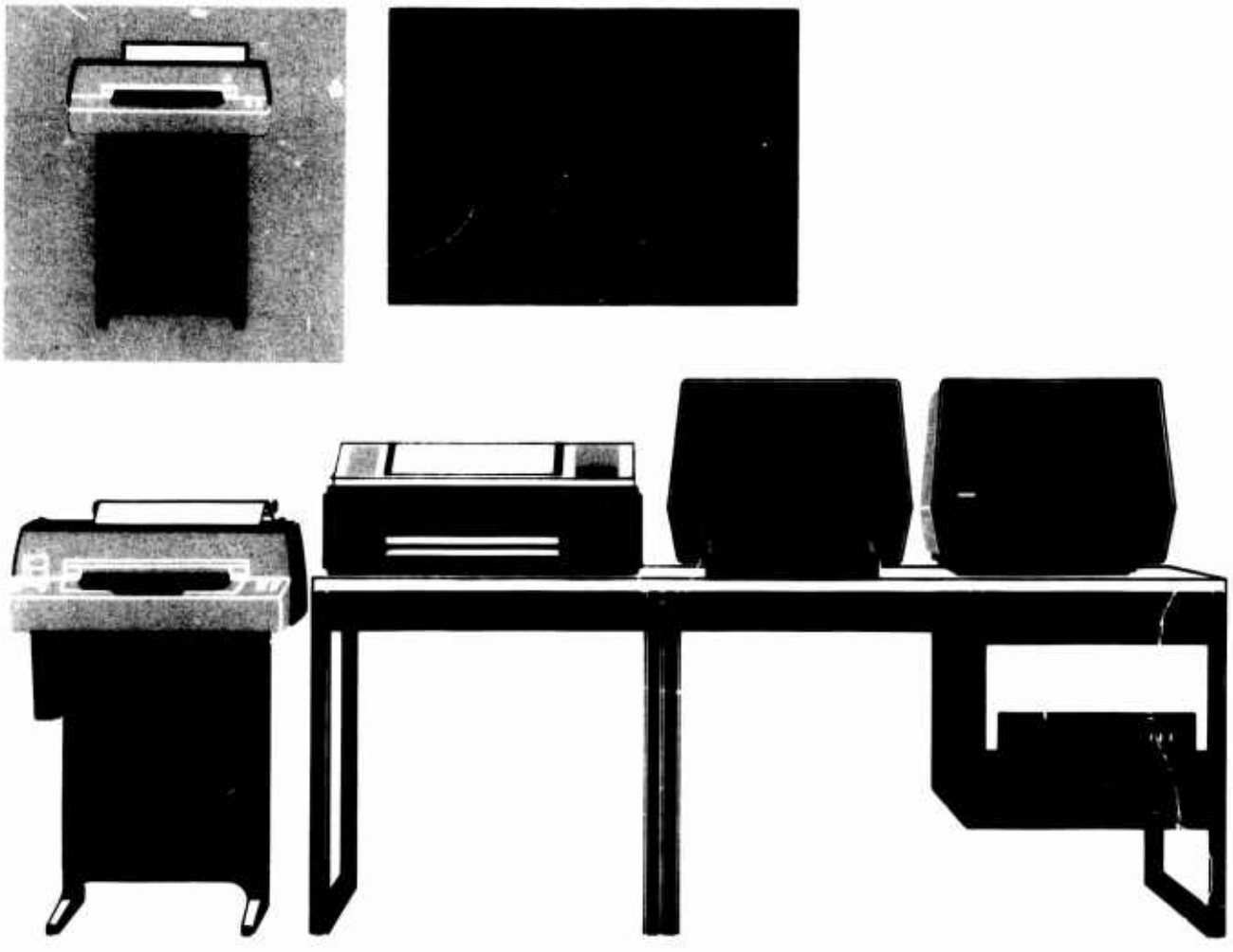
Most building automation falls into the intermediate range. Two basic configurations, with many options for each, cover this range. Both feature two-way message exchange service. Any, and all, send/receive stations can address the others and communicate at any time. One typical JC/80 system consists of the mini-computer console and the associated hardware/software necessary to provide for a medium size installation including:

Heating, ventilating, air conditioning control
Firesafety: detection, alarm and control
Security alarm and control

Usually consisting of a slide projector, an operator's console or a television display with keyboard input, a keyboard printer, and a mini-computer communicating with a remote keyboard printer, it can provide these log functions:

trend	alarm summary
high-low limits	program summary
change of state	status summary
	and others

Commands include programmable start/stop for individual points, manual start/stop, and other adjustments. Printout is identified by day, month and year. Change of state is indicated by digital display and printout. High-low limits are changeable at the operator's console or the keyboards.



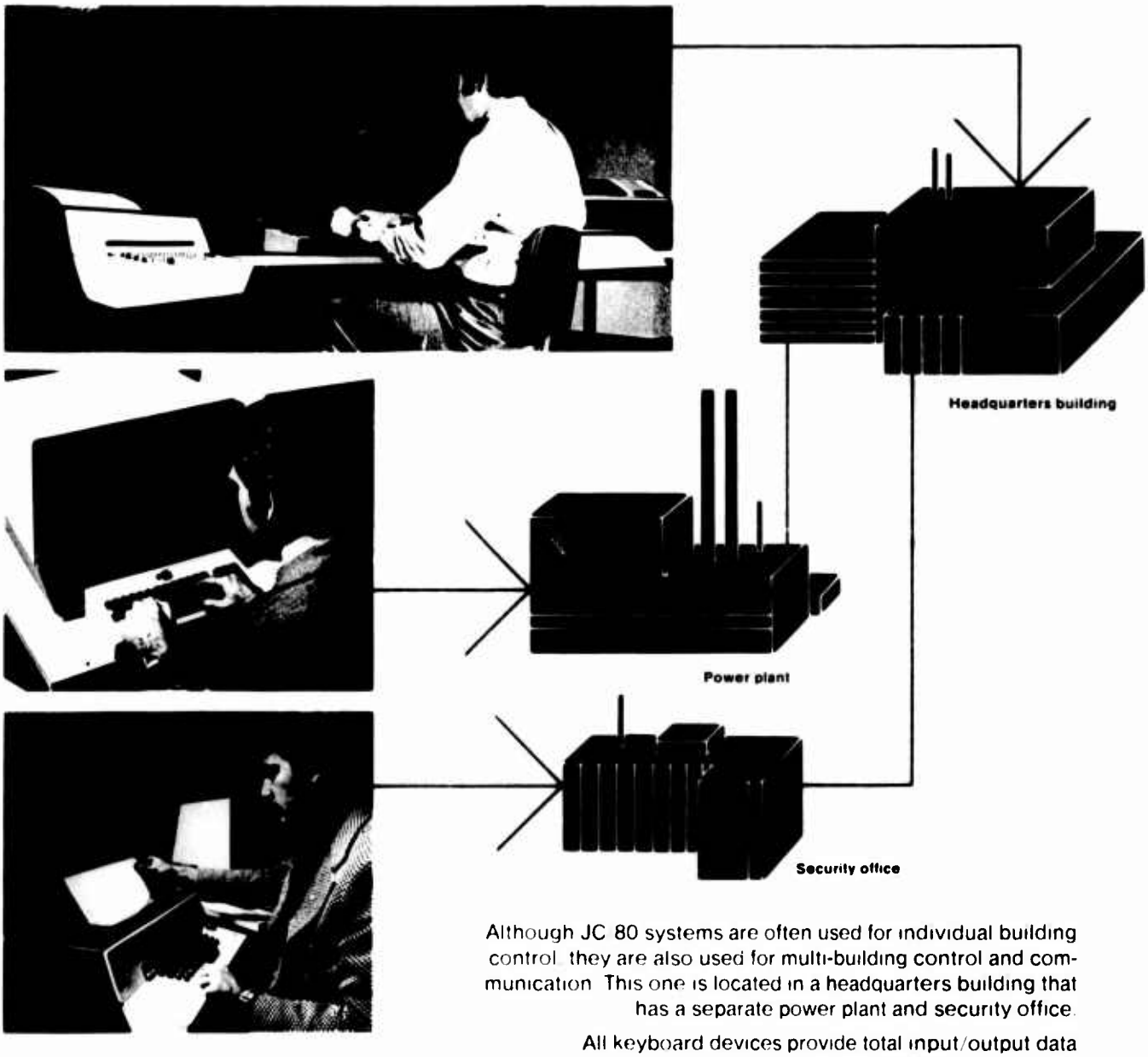
Entries are in actual values. Frequently used commands are entered through single keys assigned to specific functions. One-button operation for simplicity and efficiency.

This type of system is typically recommended for HVAC monitoring and control. Firesafety functions are easily added. Output information is available at a remote station.

A more sophisticated system providing expanded heating, ventilating, air conditioning, security and firesafety capabilities is obtained by replacing the operator's console with a television display with keyboard at the mini-computer, and adding a television display with keyboard at the remote station. Any point can be assigned to any or all output devices to allow separate security or fire monitoring posts.

This type of system provides for watchtour checks and access control in security applications. In heating, ventilating, air conditioning, it provides for individual control limits and totalizes run time and Btu consumption. A high speed printer can be added to the mini-computer to record massive amounts of system data in brief periods for management analysis, the basis for future planning and scheduling. Readouts are in system format. That is, they are in alpha/numeric (English language) form, simultaneously displayed with relative data, for quick, easy association and interpretation.

Single or multi-building automation



Although JC 80 systems are often used for individual building control, they are also used for multi-building control and communication. This one is located in a headquarters building that has a separate power plant and security office.

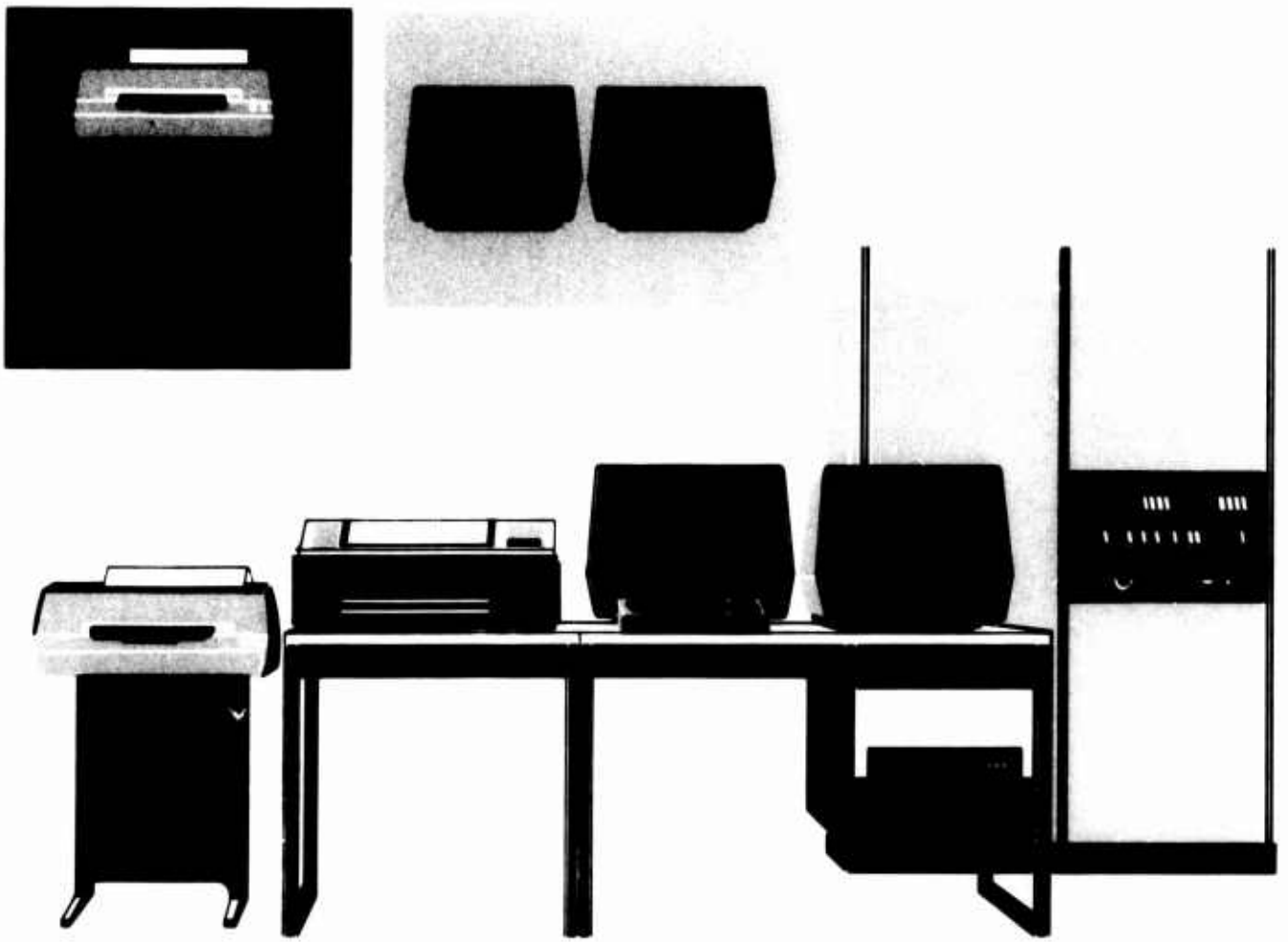
All keyboard devices provide total input/output data communications at any point.

The television display with keyboard, located in the power plant, shows the operating engineer the varying conditions within the controlled mechanical and electrical systems. It communicates this information in English-language system format. Values of controlled conditions are displayed with associated data for quick identification and interpretation.

The keyboard printer at the security office provides security control, printout of alarms, and a method of communicating with other printers throughout the system. The security office can be assigned total system control, if desired.

The printer at the central station has the capacity to gather masses of data in short periods. This hard-copy printout can be analyzed for future scheduling and increasing efficiencies.

JC/80 central systems



The next higher level of automation is the JC 80 central system Generally, a central system is used for extensive processing of data in a single system or for integrating control of two or more JC 80 systems

In its simplest form, a central system consists of a computer of expanded capability coupled with a bulk memory disc In effect, it is a JC 80 single system having enlarged capacity to provide all functions previously described, plus energy conservation routines requiring complex formulations and high speed computations

Typical applications for central systems in this configuration include

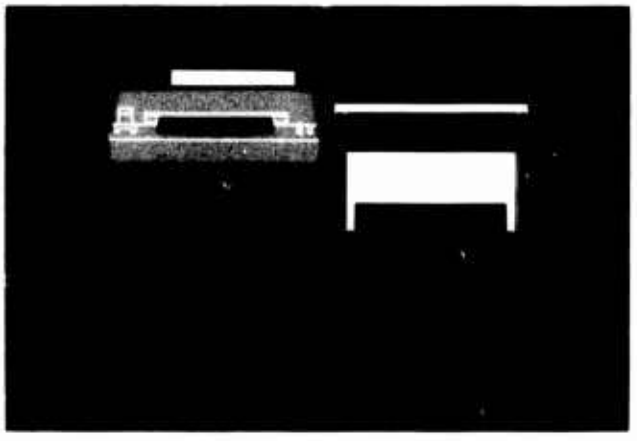
Outside air/return air enthalpy control for energy conservation.

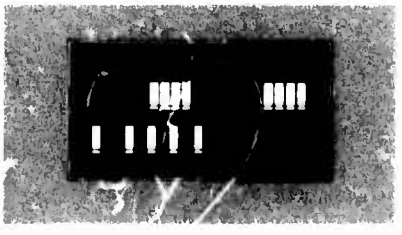
Optimizing machine start/stop control to save power costs and extend machinery life.

Provide demand forecasting of power, thus producing analytical data for better planning.

Load limiting control. This analyzes trends and regulates load usage to avoid demand penalties.

Provision of programmed maintenance data. This schedules best deployment of manpower and maintenance dollars to minimize costs.

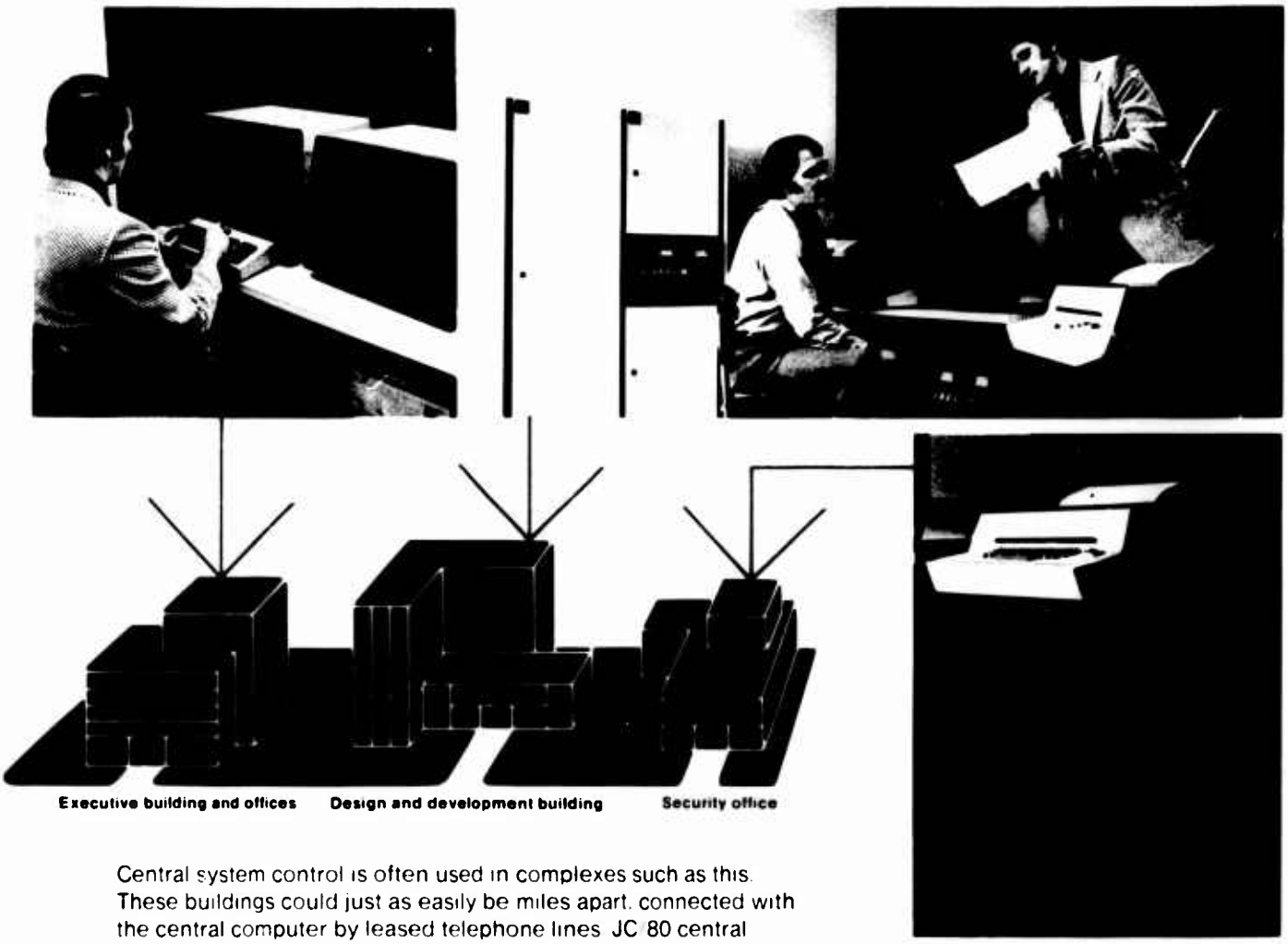




The ultimate in central systems consists of two or more JC/80 systems communicating with a large scale JC/80 computer to integrate complex system functions.

Such a system may handle several mini-computer "loops" within a single building, or several buildings within a localized complex. But it also may be processing data and controlling multiple systems over a wide area, communicating by means of leased telephone lines without losing the high speed characteristics in any part of the system.

Programmed for efficiency



Central system control is often used in complexes such as this. These buildings could just as easily be miles apart, connected with the central computer by leased telephone lines. JC/80 central systems also are used in large single buildings.

Central system energy-conservation routines provide maximum free cooling. Equipment is used sparingly. Such a system can pay for itself quickly. Power and fuel are used at maximum efficiency. Manpower is better-deployed.

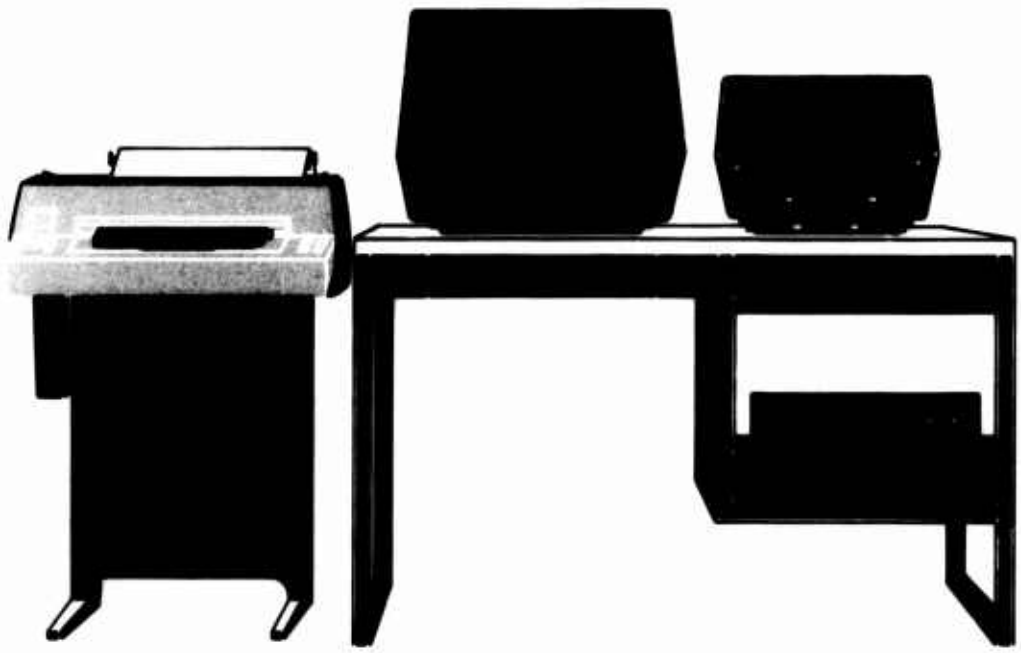
In firesafety, the JC/80 central system provides early detection and alarm, announces instructions for evacuation procedures, and automatically directs programmed smoke removal. People and property are better protected.

Programs are also provided to schedule maintenance, automatically prepare work instructions, and compare actual costs against estimated costs. The system can compile equipment repair history and evaluate productivity.

HVAC control is the most efficient possible. In enthalpy control, the JC/80 may even decide to overheat or subcool at maximum equipment capacity, if recovery costs less in fuel and power than the resultant energy loss. Power demands are limited to avoid demand penalties, and to use power most efficiently.

The central system shown controls all the buildings directly. In other applications it can accept signals from other JC/80 systems and direct their operation.

Basic system



Buildings of almost any size can realize the benefits of computerized control. At costs that permit a fast return on investment. And in a design that provides for the future.

This basic unit provides many functions and is upward expandable to incorporate others as needs grow or space use changes. As it stands, it provides full mini-computer capabilities with functions such as:

Contact alarm annunciation for more than 15,000 inputs
Two-way communication
True general purpose digital transmission
High speed response
Sequence reporting of events
Self diagnosis for system integrity
Simple operation—operator oriented

Such systems are ideal for the smaller building and are often used as back-up control for larger, complex systems. They can be re-programmed to accommodate changing needs. And they can communicate with central systems via dedicated wires or leased telephone lines.

Packaged software

The period of individually customized software for every installation is gone. With the JC/80 system, a comprehensive library of standard operating software modules is available as off-the-shelf packages. In effect, the variety of modules allows individual design by selection.

The difficulties of adapting a standard building automation system to a wide variety of building plans and complexes and their infinite variety of input point configurations are also solved. The solution lies in Johnson's system generation technique and a two-level division of JC/80 software: 1) the operating system and 2) the data base.

Organized and formatted into the first category at the factory, operating system packages are thoroughly tested for proper operation. They are then validated, shipped to the branch office and loaded into the core memory.

Specific configurations of analog, binary, fire alarms, start/stop, and others are then loaded into the core memory. This constitutes the data base.

This simple system generation procedure means that modifications of the operating system and the data base are immediate, on location and locally controlled.

System integrity

All JC/80 system requests are acknowledged. Impossible instructions are automatically rejected and the operator is told why. If a point does not respond to an operator's instruction, it is re-transmitted. If nothing happens then, the operator is advised. JC/80 systems also feature priority interrupt to make detection and reporting independent of "scan time." Reportable events get immediate attention. Regardless of system size. And cascading malfunctions are reported in order of occurrence. All systems also have pre-programmed diagnostics for on-line supervision of system integrity.

Why a JC/80 building management system?

Firesafety
Security control
Reduction in utility bills
System format
English language
Increased productivity
Reduction in machine run time
Full input/output devices
Software programmable
Operator oriented
Management by exception

JOHNSON
SERVICE COMPANY
MILWAUKEE, WISCONSIN • 53201

Publication No

Building Operations Breakthrough!
New JC/80 Automation System

mini computer control emerges

Owners recognize the advantages and necessity of building automation. Lowered operating costs resulting from increased efficiency of manpower, equipment, energy and power use have long been proved. Although first cost is still important, designing buildings and systems that operate at peak efficiency at all times is one of the greatest challenges facing industry.

We have progressed in this direction. All properly applied automation cuts energy waste. Centralization further improves energy conservation. Computerization does even better. Continuously on line, a computer can instantaneously make decisions previously assigned to men, compare dynamic performance against stored ideal conditions, and direct operations to achieve these ideals.

Upgrading fire alarm and signaling systems is another concern today. Formerly, owners relied on automatic detection equipment in combination with manual alarm stations. Studies indicate the necessity to incorporate a good communication system to automatically alert and direct building occupants. One with the intelligence to respond rapidly to a variety of fire conditions. Already industrially-proved, the mini-computer is becoming that vital intelligence link.

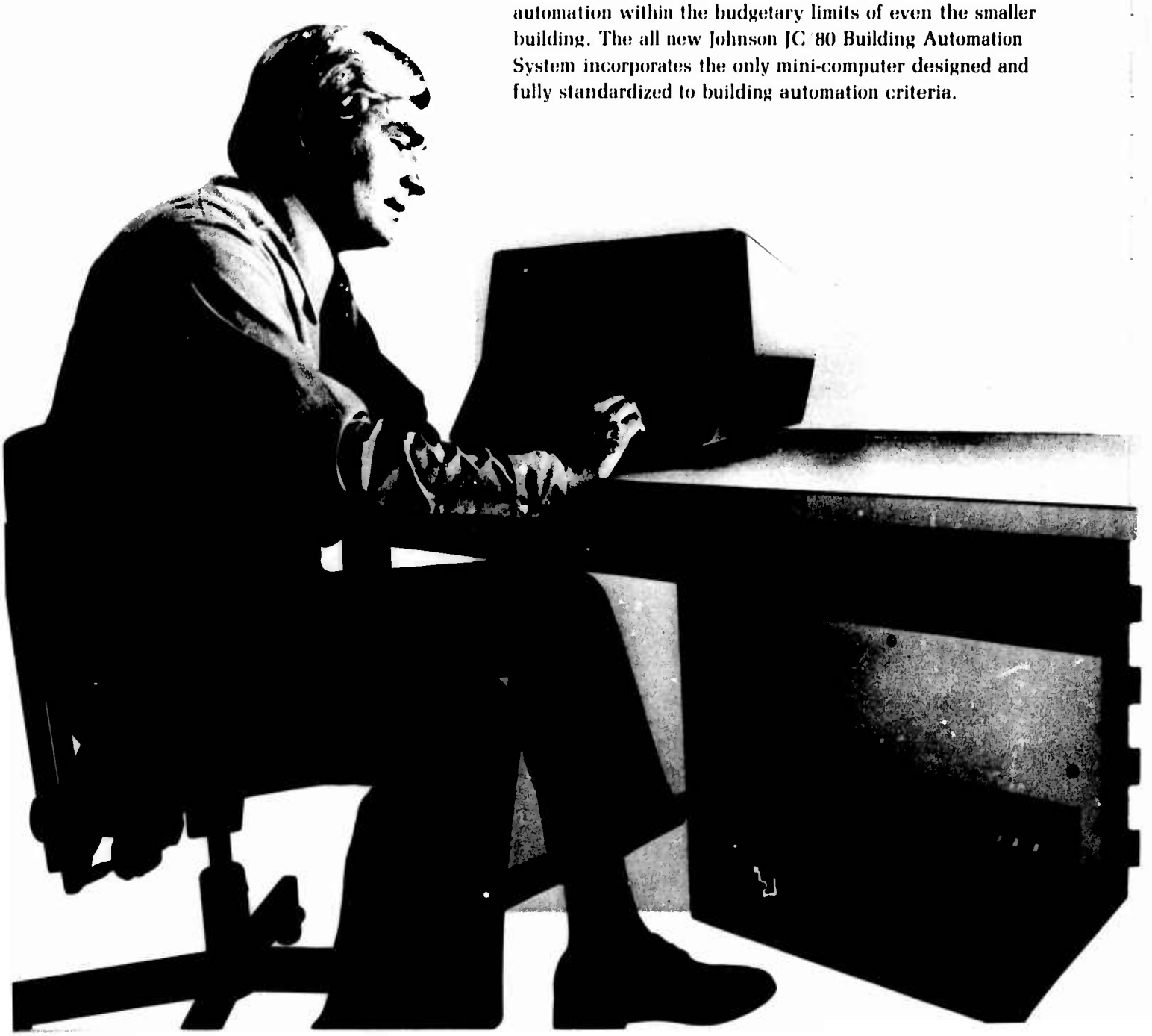
Computerized automation can also upgrade maintenance and operations. Cost-to-repair, downtime analyses and similar management data are economically available.

Previously, computer control was too expensive for the smaller building. The introduction of the JC 80* System changes this. Now buildings and complexes of every size can realize the benefits of computerization. And at a cost that permits full return on investment now, in a system that accepts future technology. The payoff on centralized building automation originally was about five years. Today it is two to three years, and the JC 80 System makes possible even faster payoff.

*Reg TM applied for

a major creative breakthrough

Now, Johnson introduces modular, computer-controlled automation within the budgetary limits of even the smaller building. The all new Johnson JC 80 Building Automation System incorporates the only mini-computer designed and fully standardized to building automation criteria.



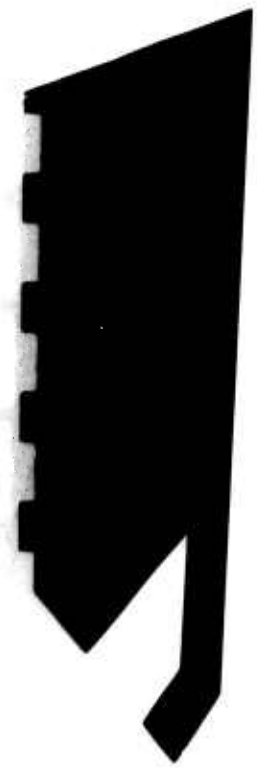
In the JC 80 System, the Johnson organization provides, for the first time:

- A totally computerized building automation product line, end-to-end.
- A true general purpose digital communications system.
- Economical leased line transmission compatibility without degrading system performance.
- Portable operators' consoles for maintenance or system back-up.
- Replacement of "Scan Speed" with "Total System Response Time" as an improved figure of merit for performance.

the modular approach

The simplest JC 80 System configuration is the Stand-alone System. This consists of a single loop communication network built around the first and only mini-computer designed for building automation. It provides:

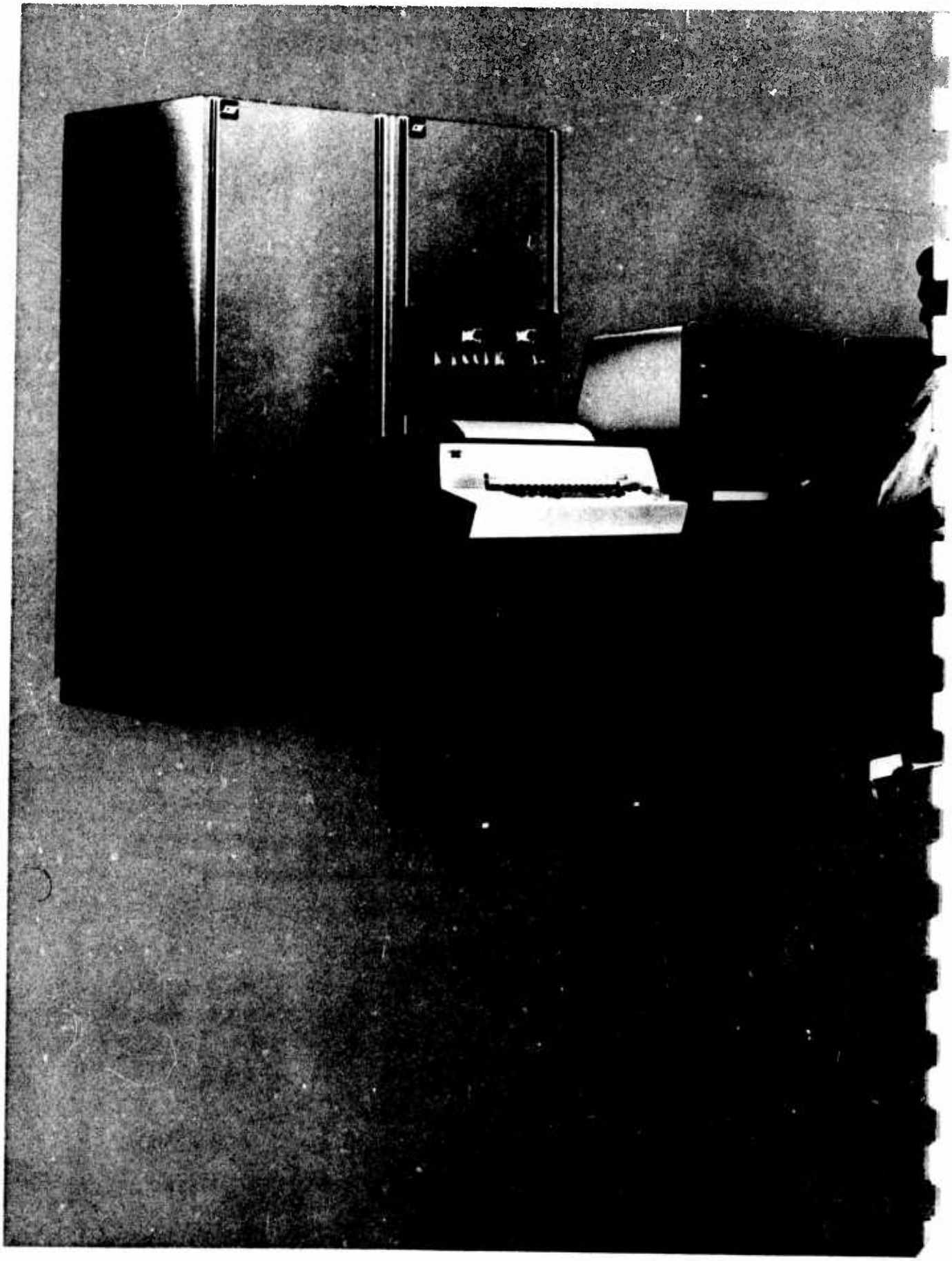
- Contact alarm annunciation for more than 15,000 inputs.
- Full capability mini-computer controller. Upward expandable with plug-in hardware and software modules.
- Operator communication in fixed or portable consoles.
- True digital transmission with digital supervision techniques. High speed—500,000 bits per second—to operate at true computer speed.
- Faster system response. Averages less than 1 second. A maximum of 4 seconds to detect alarms, regardless of system size. No scan waits.
- Sequence reporting of cascading malfunctions occurring as close as 0.005 second.
- Simple operation for supervision, fault location, correction, repair. Digital check-before-execute procedures.
- Prompt delivery with fast, reliable installation and start-up.
- Economical computerized control right from the start. No waiting until later for computerization.



expanding the stand-alone

The unique hardware/software modular designs featured in the JC 80 System simplify expansion. Any, or all, of the following options can be incorporated into the original installation, or they can be added later with off-the-shelf software modules as the system grows or requires change:

- System Format presentation.
- Analog indication in easily understood language.
- Individual analog limit assignment and comparison.
- Manual two- and three-mode switching.
- Manual set-point and position adjustment.
- Automatic change-of-status and alarm print-out.
- Alarm summary demand logs.
- Motor summary demand logs.
- Trend logs.
- Programmed start stop, including seven-day individual motor operating schedules.
- Remote teletypewriters and other communications terminals.
- Fire alarm.
- Security/intrusion alarm.
- Economical price that pays off fast.



central system

The loop mini-computer can be connected to a larger JC 80 Central System computer for more extensive data treatment. For large building complexes, such as college campuses or other multi-building applications, multiple loop mini-computers can be connected to the JC 80 Central System.

Efficient computer-to-computer communication is by means of dedicated wiring or leased telephone lines operating in full or half duplex modes. Because of the unique and efficient message structure and the minimum message transfers required in the JC 80 System, the relatively slow speeds of voice-grade leased telephone lines can be employed without the degradation of system performance so characteristic of other building automation system scanning techniques. The JC 80 Central System provides these additional features:

- Central processing unit (CPU) and magnetic disc bulk storage in matching cabinets.
- Full CRT display and English language keyboard data entry.
- Wide variety of peripheral devices. Remote, if required.
- Economical modular add-on software.
- Expanded English language outputs—display and printout.
- On-line economization control.
- Maintenance management and information systems.

The new JC 80 System offers a completely modularized computerized building automation package at the price of other non-computerized "digital" systems. A high speed general purpose digital system that is compatible with other true digital systems. A system which doesn't dead end you, one that provides the simplified automation required now, but which can be expanded to any size in the future, at any growth rate. A system that can start very small, but grow very big, at your own pace. The JC 80 System is the only building automation system designed to take continuing advantage of the ongoing technology of the digital communications and computer industries, valuable insurance against obsolescence.

retaining innovations

Many Johnson "firsts" and widely imitated exclusive features of the past have been retained in the JC 80 System. Among them are the System Format and the Management by Exception concepts. And most important, JC 80 automation is compatible with previous Johnson digital systems. This is another example of Johnson's proven history of protecting yesterday's customer investments with tomorrow's technology.

Management by exception is a time-tested technique for achieving management objectives. Before a JC 80 System is designed for a building, Johnson engineers, the building consulting engineers, architects and management determine the objectives that the automation system is to realize. The system is then so designed that these objectives are established and achieved as the normal conditions. Then, only messages communicating "exception" conditions are transferred, thus minimizing line, processing and operator time.

Although the JC 80 System offers the most sophisticated control available, combining management by exception and "human orientation" makes it simple to operate. Fewer communications are required, and these consist of easily understood English language inputs, printouts and displays. Retaining system format design concepts makes the JC 80 CRT Console easy to use and greatly reduces operator error.

design considerations

In designing the JC 80 System, Johnson engineers have also considered compatibility with existing digital systems and anticipated future systems among their prime design criteria. The result is a system that is compatible with past digital installations and is self-insured against obsolescence. Owner investments in true digital systems are protected now, and in the future.

The result of these considerations is a family of software-compatible machines incrementally sized to match requirements of various sized buildings. The JC 80 Mini-computer is designed to the specifications of Johnson engineers for use in building automation and management systems. Extreme miniaturization and reliability, combined with reasonable cost, is achieved by use of the latest in integrated circuitry. Johnson retains absolute control over any and all changes and updates in the mini-computer itself. This control of design allows us to assure continued compatibility in digital automation systems since improvements will be incorporated consistent with advances in mini-computer technology and our building automation criteria. Thus, JC 80 Systems are protected from instant obsolescence caused by rapidly changing mini-computer technology.

getting it on line–on time

Modular, off-the-shelf hardware and software insure on-time delivery. Efficient, on-schedule installation and commissioning and Johnson's unique "system generation" flexibility mean on-time operation. Long experience with design, installation and servicing of computerized systems provides the effective inter-professional, inter-trade coordination essential to efficient installation.

Minimum wiring is required. All JC 80 System electronic components are packaged on plug-in printed circuit boards, eliminating most "pre-wiring" requirements, and all digital communication is over a simple coaxial cable. Since all hardware and software packages are carefully tested at the factory under actual operating conditions, on-site commissioning and start-up procedures are minimum.

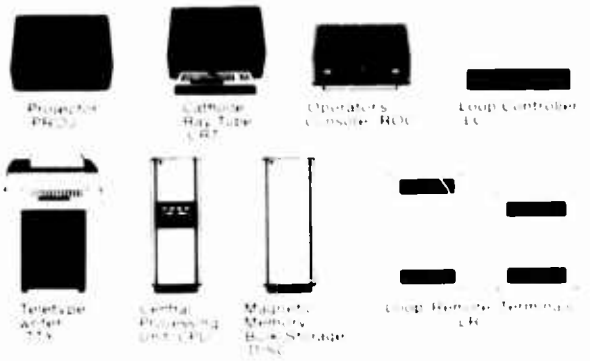
experience plus

Independently-compiled statistics document more than 50 computerized building automation installations. Johnson is responsible for more than 40 of them! We have passed through the period of early learning associated with the introduction of computer technology. In addition to design and installation expertise, we have a computer maintenance and service capability already widely established on the local level. And this capability is growing every day.

lowering costs...as you start and as you grow

Cost has also been considered in standardizing hardware software for the JC 80 System. Both are completely compatible across the entire line of computers used in the various system configurations. Expansion and customization are accomplished by addition of standard modules without the necessity of replacing any existing system hardware or software.

how it works

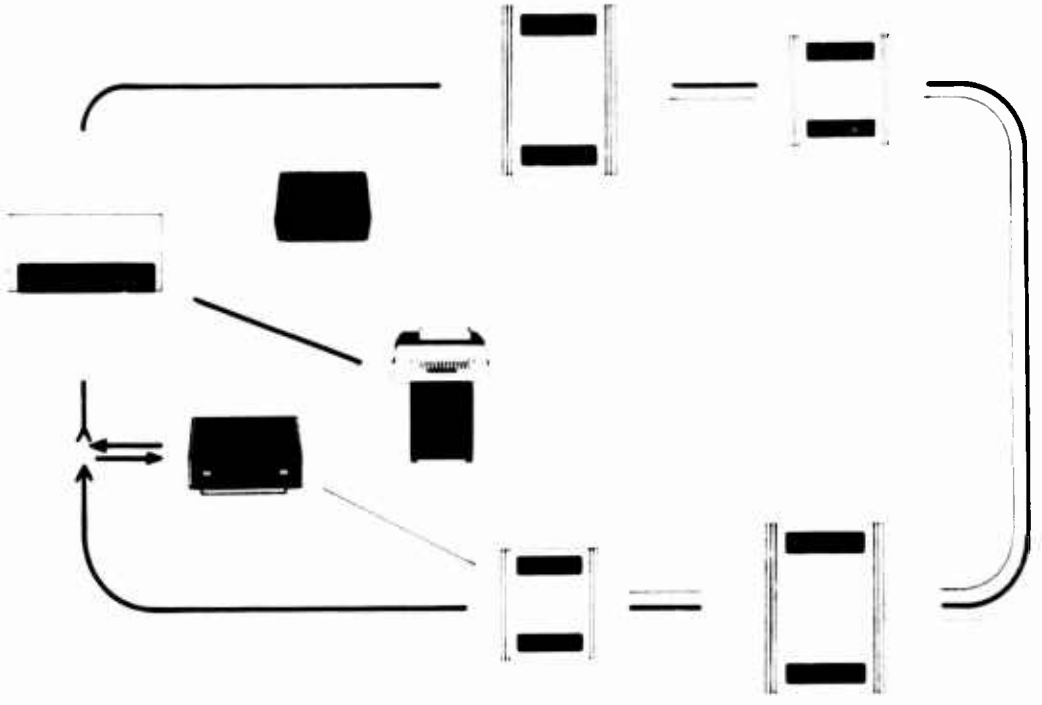


The JC 80 Building Automation System consists of a high speed digital communications loop. It is built around a real-time mini-computer which provides the intelligence for the system and acts as the Loop Control Terminal (LC) interacting through a simple two-wire coaxial trunk cable with Loop Remote (LR) Terminals connected in series. See Fig. 1.

The 2,000-word, 16-bit mini-computer generates 36-bit frames, which are transmitted around the communications loop at 500,000 bits per second. The frames contain address information, data, status and parity checks. They serve as vehicles of information transfer. The LC mini-computer surveys the condition of all monitored

Fig. 1: Typical Stand-alone system. First level building automation functions of monitoring, alarming, displaying, printing out and programming start/stop, are provided by a Stand-alone single loop. The operator communicates with the various Point Modules (PM's) by means of an operator's console. This console may be a portable unit, a permanent installation, or combinations of both. A teletypewriter is optional. These devices can be located anywhere in the loop, but normally are located near the LC.

The system is truly modular. A Master Chassis (MC) and add-on frame, called a Slave Chassis (SC) are used to install PM's. Every chassis has a power supply rated at the maximum power required for the electronics in its circuit. Up to 62 PM's can be used for each LR location and 31 LR's can be connected to the loop.



Intercom, where required.
Coaxial cable.
Analog, where required.

points in the loop and provides output signals to annunciate changes to the operator.

The various monitored points, controlled functions and controlling elements exchange information and commands with the LC processor by means of the frames processed through the LR's and a dedicated control module, called a Point Module, or PM, located at the LR chassis. Functions can be added to the system by adding both a PM card to an LR and a corresponding software module to the LC mini-computer.

design and installation

Each LR has a capacity of 62 PM's. The system itself is upward expandable from a simple LC, having a maximum of 31 LR's in the loop, to a large JC/80 Central System. The Central System can connect multiple JC/80 Loops.

Data communicated between an LC and the JC/80 Central System is digital in format and is restricted to "exceptions." The LC, continuously monitoring its inputs, transmits single point information only when it determines a change from normal limits in monitored conditions has occurred. The Central System also provides command messages such as a start instruction over the communication link. Thus, the JC/80 Central System differs from other computer systems in that

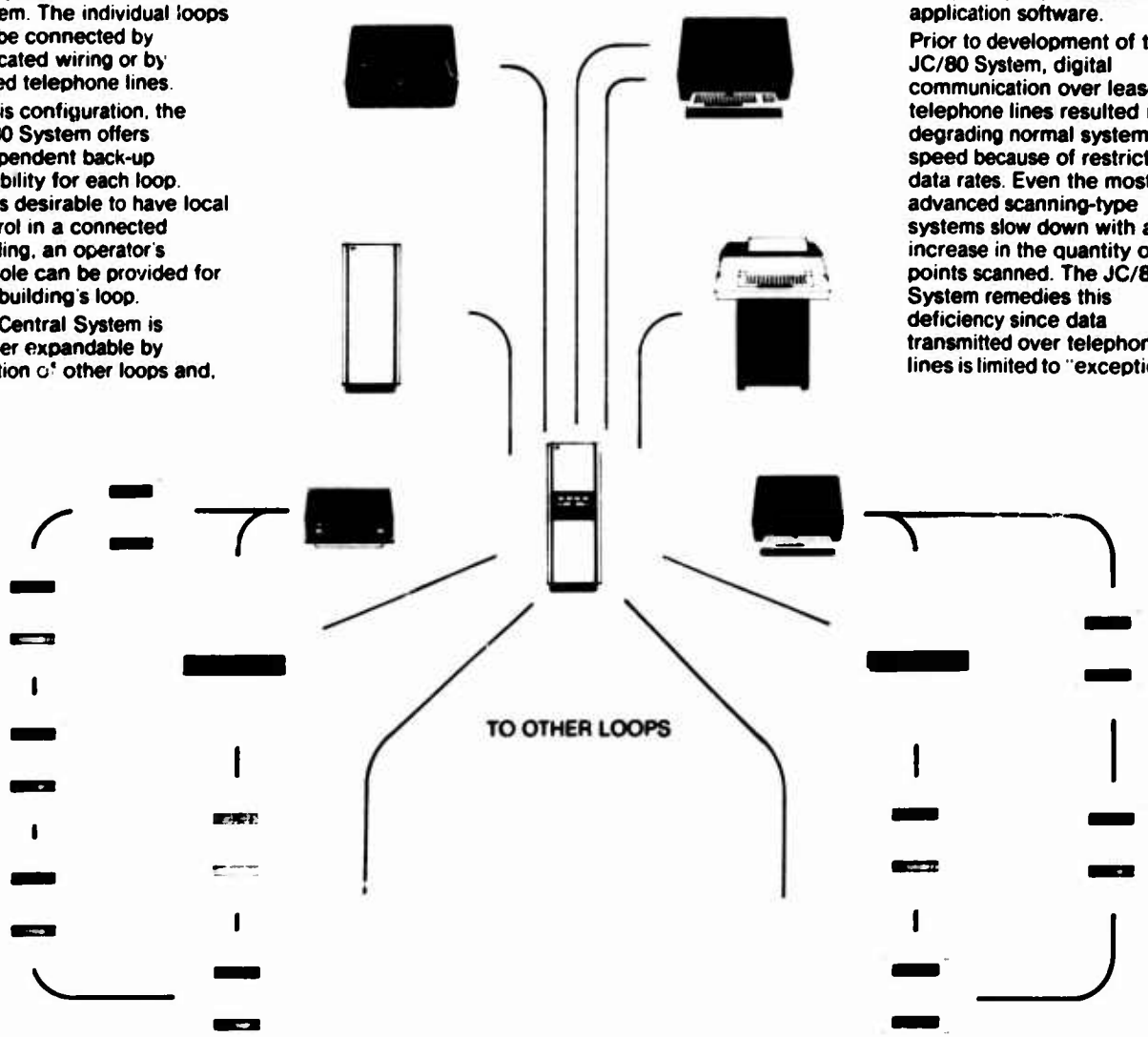


Fig. 2: This is a block diagram of a typical multi-loop Central System. The individual loops can be connected by dedicated wiring or by leased telephone lines.

In this configuration, the JC/80 System offers independent back-up capability for each loop. If it is desirable to have local control in a connected building, an operator's console can be provided for that building's loop.

The Central System is further expandable by addition of other loops and, if required, additional computer peripherals and application software.

Prior to development of the JC/80 System, digital communication over leased telephone lines resulted in degrading normal system speed because of restrictive data rates. Even the most advanced scanning-type systems slow down with an increase in the quantity of points scanned. The JC/80 System remedies this deficiency since data transmitted over telephone lines is limited to "exceptions."

it is not assigned time-consuming, repetitive, scanning tasks. It acts only when an exceptional condition requires attention. This means that the longest time required to detect a changed condition, for example, a fire alarm contact closure, equals the maximum time required to detect such a condition on the largest loop. Typically, this will average less than 1 second; however, even in a fully loaded loop (in excess of 10,000 points) the maximum response time is 4 seconds. See Fig. 2.

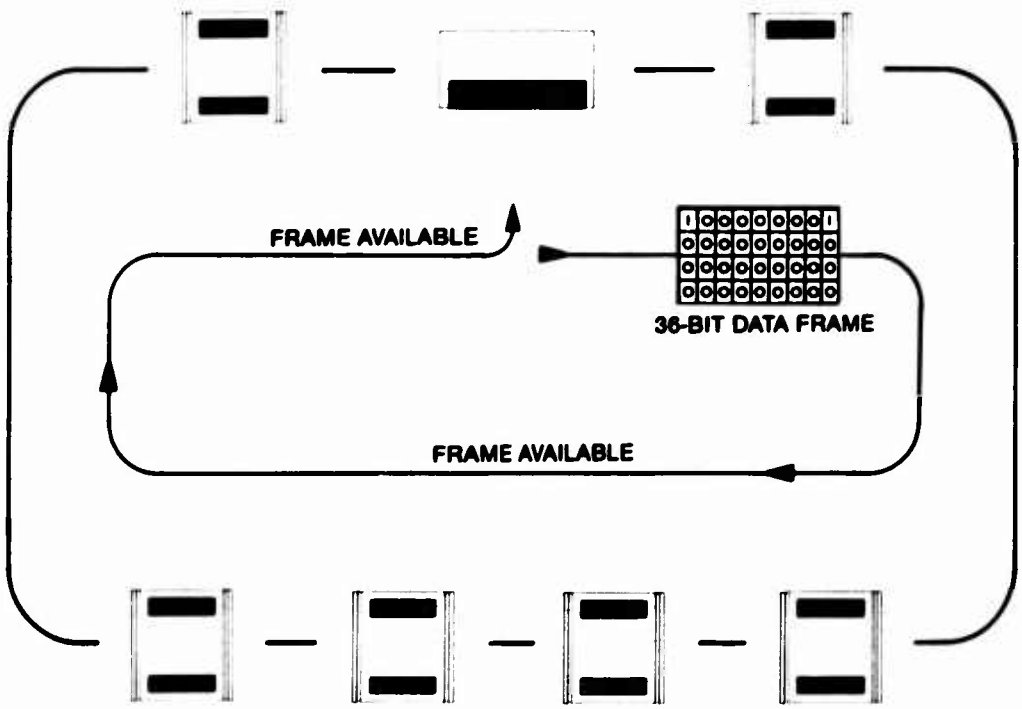
Remote operators' consoles, can be plugged into any LR location to establish communication with any point in the system. This convenient feature increases manpower efficiency and provides maximum mobility.

loop operation

The mini-computer generates and receives digital pulse signals as a 1 or a 0. A word is formed by a combination of 16 such pulse combinations or "bits" to the computer. Different combinations of 1's and 0's constitute different words of instruction and make the information intelligible to the computer loop controller.

The LR's also have the ability to interpret these words. But the mini-computer is additionally able to organize, generate, and transmit a combination of 36

Fig. 3: How an available frame circulates around the communications loop.



such bits as a "frame" of information. See Fig. 3.

The frame of bits is transmitted around the communications loop serially at 500,000 bits per second. Effectively, this is 7,000 frames a second with a pause between frames for differentiation of the bits.

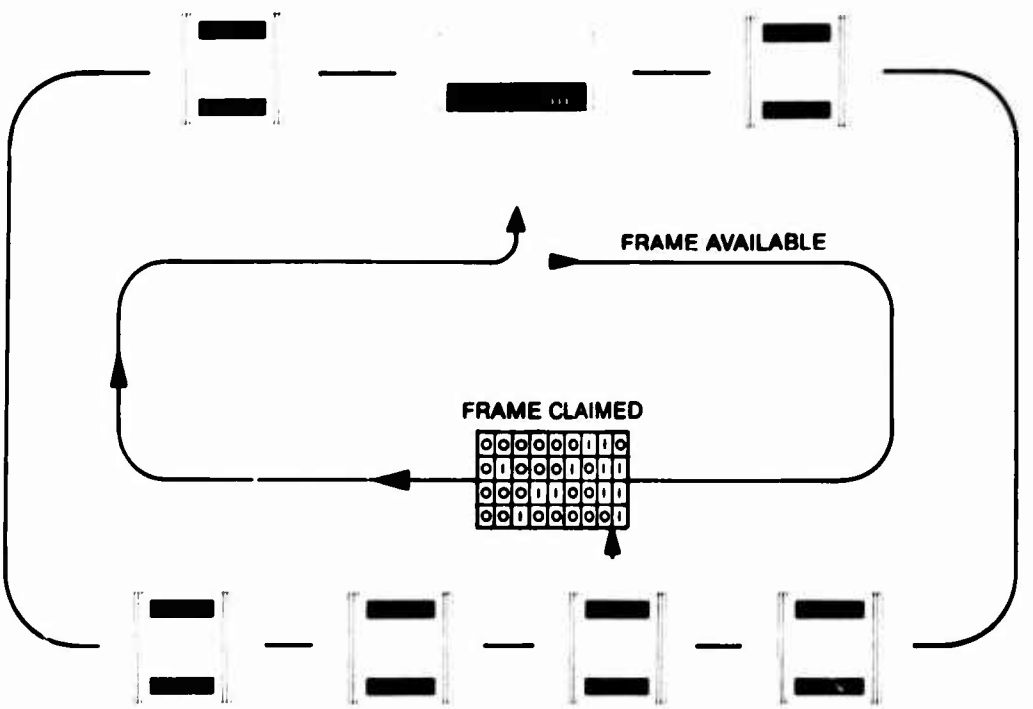
The configuration of 1's and 0's in the frame identifies it either as dedicated to a definite LR and PM, or as one that is available to any LR for exchange of information with the LC.

If a frame is claimed by an LR, it is no longer available to any other. See Figs. 4 and 5. Other loop remote terminals must wait for a subsequent available frame before they can transmit information to the LC. The wait is short, however, since the loop is operating at an average of 7,000 frames per second.

The LC also decodes and interprets information from the operator's console or from the Central System. If a result shows that a command must be issued or information from a point is required, the LC generates a dedicated frame and transmits it to the appropriate LR.

Both the LC and the LR can also recognize the absence of frames and interpret this as a source of trouble since frames should always be circulating around the loop. See Fig. 6. Such supervision is a

Fig. 4: How an available frame is used by an LR to transfer information to the LC. Once claimed, the frame is unavailable to all other LR's.



prerequisite for "infallible" control of system operation and is a requirement for approval by accrediting and regulatory agencies governing applications such as fire alarm systems. Every LR recognizes when it ceases to receive frames. After a short delay, it generates a "trouble" instruction which continues around the loop to the LC. The LC recognizes this and advises the operator of the trouble location. The system is not only self-supervising, it identifies and locates the exact trouble for ease of correction.

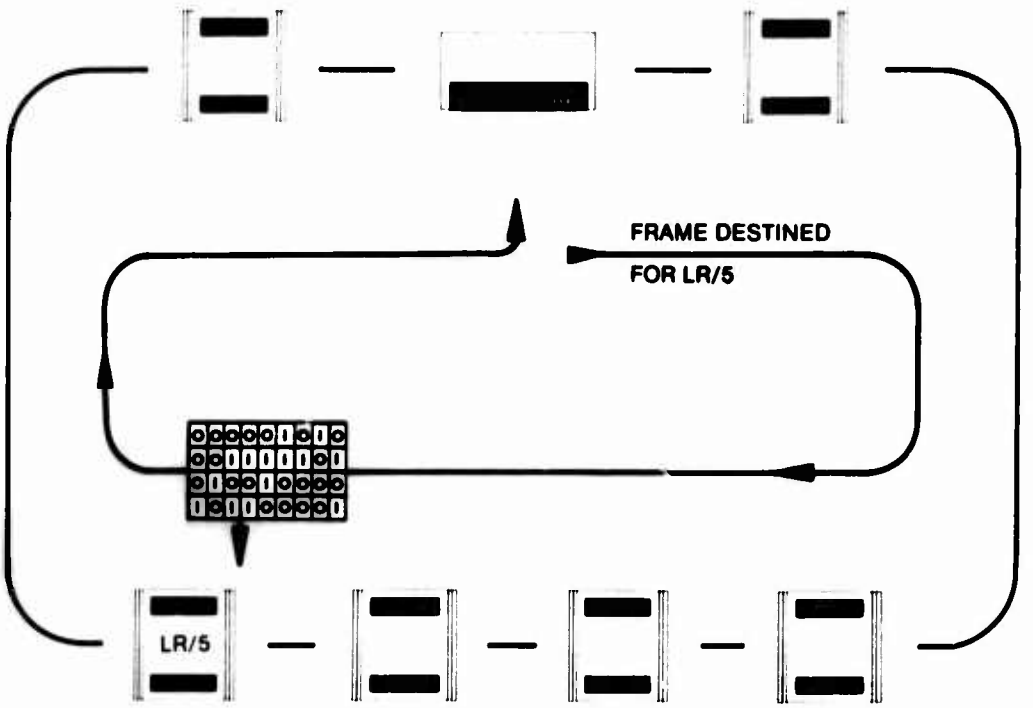
signal integrity

Digital communication on the JC 80 System loop employs widely used, efficient, error-detection techniques. No fewer than five parity bits are embedded in the 36-bit data frame to detect the loss or gain of erroneous bits. In addition, the JC/80 System loop utilizes acknowledge/no acknowledge and check-before-execute procedures. A validating two-way verification must occur between the LC and a particular point before message transfer occurs. This is true signal validation.

falls soft

The JC/80 general purpose communications system incorporates the principle of "graceful degradation."

Fig. 5: How the LR receives information and commands from the LC.

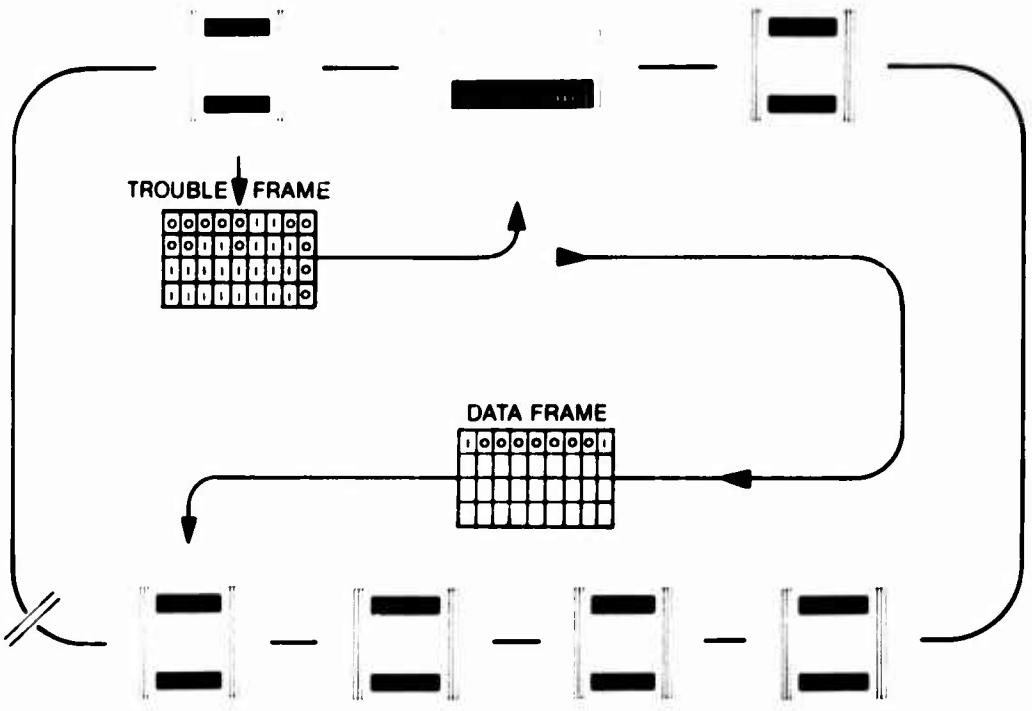


A failure of one element does not cause a total loss of operation. For example, if there is a faulty LR in the loop, it is simply by-passed and the remainder of the loop remains functional. In the large JC 80 Central System, portable plug-in communication is available for uninterrupted control. Important assurance for building owners and managers against cascading failure of automation.

all-in-one concept

The all-encompassing capabilities of the JC 80 general purpose communication loop are readily apparent. Such basic building functions as fire alarm systems, intruder security systems, master secondary clock systems and remote communications terminals can now be incorporated into one control system with building environmental control. Unlike other systems, which merely interface with various subsidiary systems, the JC 80 System addresses itself to responsibility for total building systems management.

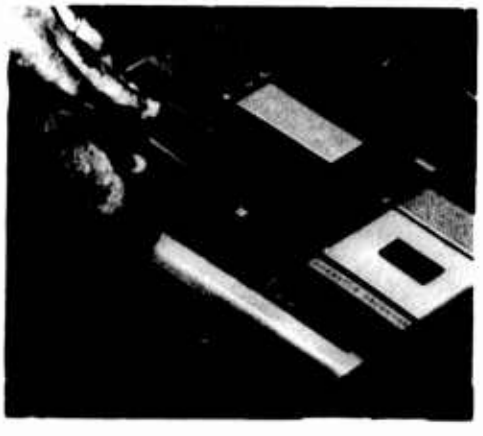
Fig. 6: How a trouble frame is generated by the first LR not receiving data frames



packaged software

The period of individually customized software for every installation is gone. With the JC 80 System, a comprehensive library of standard operating software modules is available as off-the-shelf packages to permit purchase of only the features and options desired for a given installation. In effect, the variety of options allows individual design by selection. There is no forced acceptance of unrequired features.

Since the JC 80 System is totally computer-based, the central equipment is virtually independent of hardware changes as its capabilities are increased or changed. For example, adding a start stop program control option normally requires no hardware. Instead, a standard software module is easily added at any time. Customized software is still available for special applications.



Johnson's unique system generation process includes duplicating the input programs on magnetic tape cassettes. If the program is ever erased, it is easily reinserted into the mini-computer by playback.

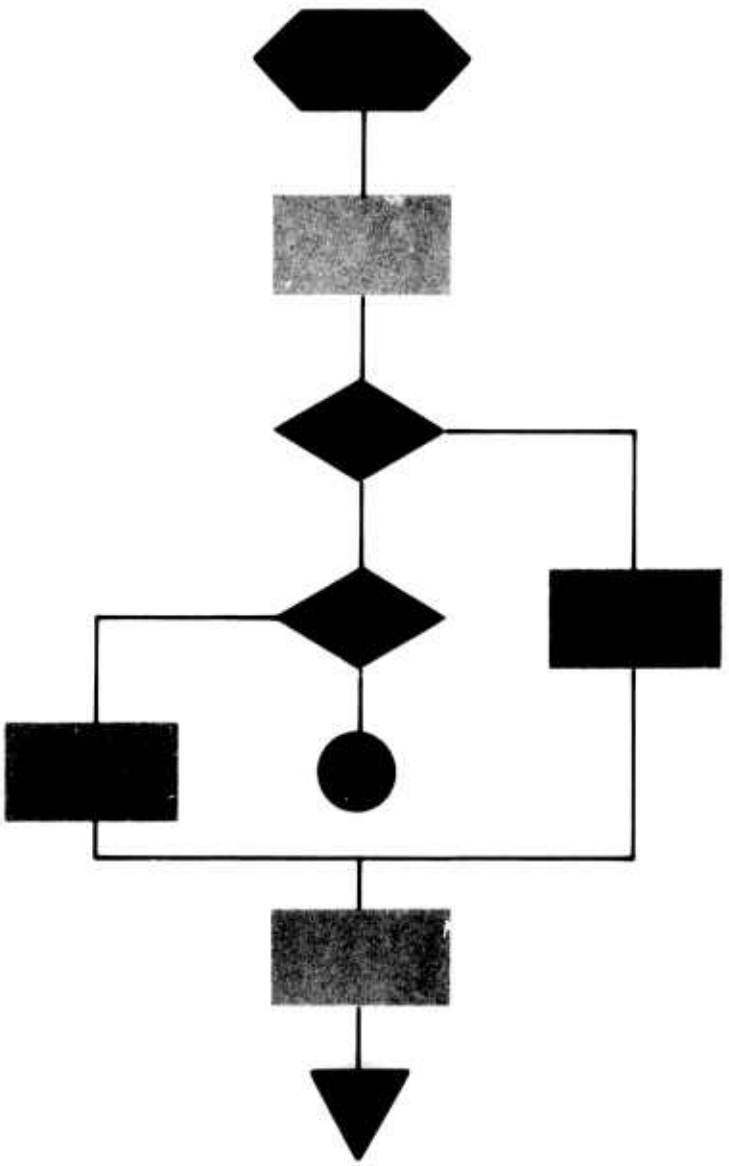
system generation

The difficulties of adapting a standard building automation system to a wide variety of building plans and complexes and their infinite variety of input point configurations are also solved. The solution lies in Johnson's system generation technique and a two-level division of JC 80 Software: 1) the operating system and 2) the data base.

Organized and formatted into the first category at the factory, operating system packages are thoroughly tested for proper operation before they are validated and shipped to the branch office. Local installation experts select the modules required for a given system and load the operating modules into the loop controller core memory under keylock conditions.

Specific configurations of LR's, PM's and point types—analog, binary, fire alarms, start stop, and others—are then loaded into the core memory. This constitutes the data base.

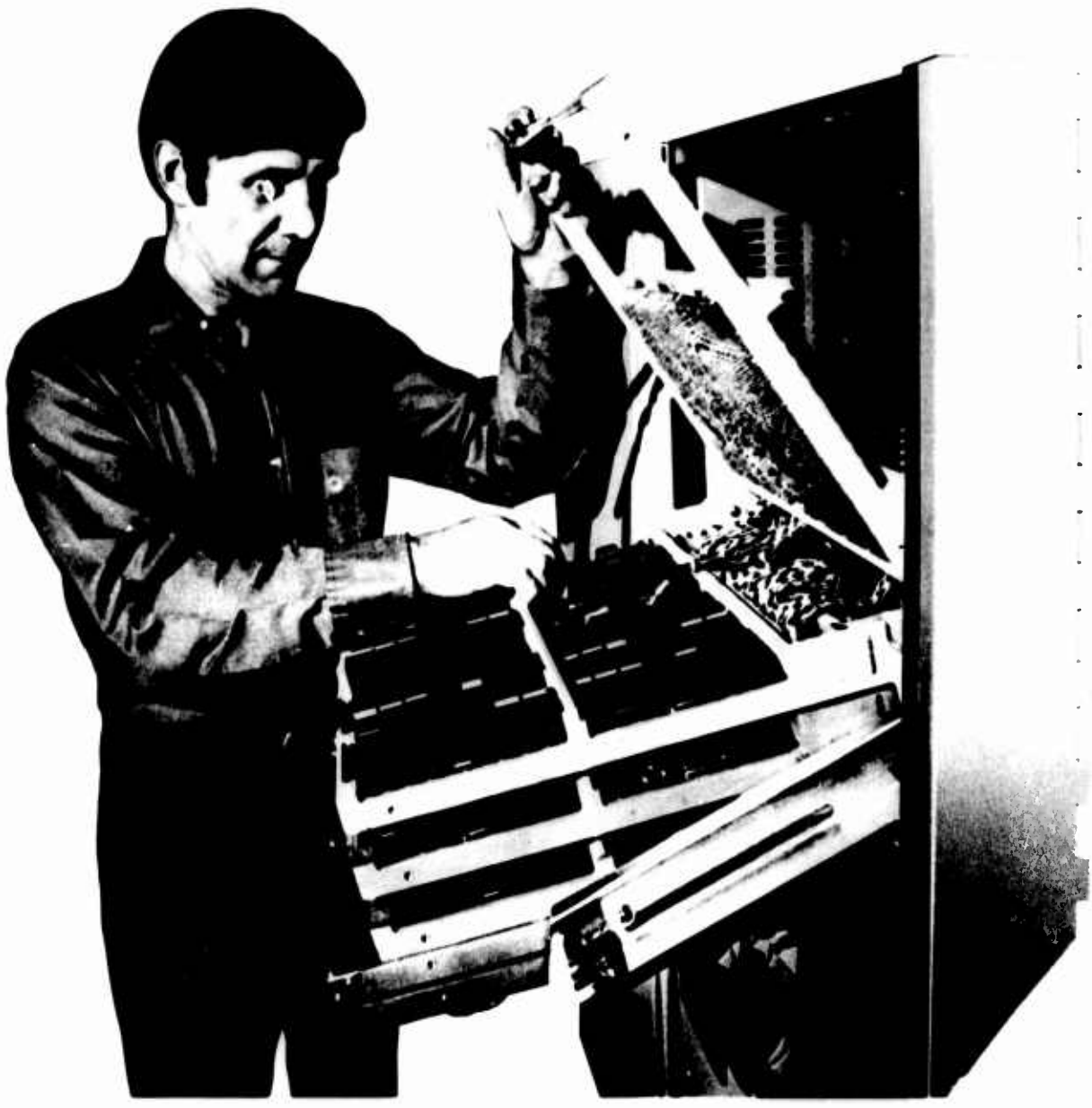
This simple system generation procedure means that modifications, additions and deletions in the operating system and the data base are immediate, on location, and locally controlled. There is no waiting for factory delivery.



people make it happen

Time-tested performance of Johnson people, from sales engineers through production and shipping, proves that we successfully deliver quality products and systems, on schedule. Then, building automation's largest, best-qualified field organization puts it all together for on-time commissioning. We have earned our reputation for excellence in the systems field. We started manufacturing and installing systems in 1885. We still lead with advanced breakthroughs.

No other building automation company offers the depth of talent the Johnson field organization provides. We offer undivided responsibility for everything we produce and install, from raw product to systems engineering, installation and continuing maintenance and service. This commitment extends



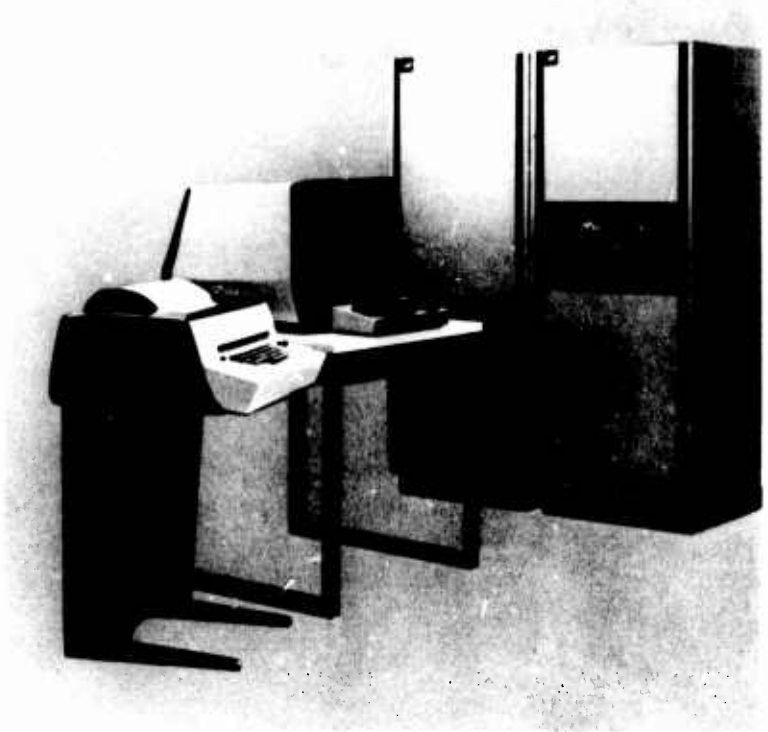
from our factories through 114 branch offices throughout the United States and Canada. We have parallel capabilities worldwide.

Fully staffing these offices with engineers, technicians and skilled craftsmen, continually updated through factory training programs, Johnson offers a reservoir of capable manpower unmatched in building automation. And our capability grows daily. In addition to installing and servicing our own computerized systems, we are also the exclusive international service organization for computers manufactured by Modular Computer Systems, Fort Lauderdale, Florida.

Lifetime service is available to every user of Johnson controls. We never lose interest in a system. We base this claim on maintaining resident mechanics in more than 300 other cities to augment branch office services.

And our experience with computer-controlled building automation systems over the past decade means that we aren't learning at your expense. An important consideration when evaluating suppliers. Be sure your automation contractor is above the knee of the "Learning vs. Expense" curve in both computer and building construction technologies, or you may be paying some unexpected "tuition."

Equipment availability is not enough. Proper hardware software packages, system generation capabilities, experience with computer-controlled building automation and local availability of trained manpower and required components are all key ingredients for successful computerized building automation installation and operation. Johnson has them all.



computerized building automation vocabulary

Analog:
Pertaining to representation by means of continuously variable physical quantities. Contrast with Digital.

Analog-to-Digital Conversion:
The process of converting a continuously varying quantity such as voltage or frequency to a finite number suitable for direct processing by a digital computer or processor.

Automation:
The implementation of processes by automatic means. The conversion of a procedure, a process, or equipment to automatic operation.

Binary digit:
Either of the characters, 0 or 1, representing one of two possible states.

Bit:
A binary digit.

Byte:
8 bits.

Cathode Ray Tube:
A special purpose electron tube used for displaying data visually on a fluorescent screen by deflecting electron beams controlled by voltage or current. Abbreviated CRT.

Central Processing Unit:
That part of a computer which includes the circuits controlling the interpretation and execution of instructions. Abbreviated CPU.

Central Processor:
Same as a CPU.

Check:
A process for determining accuracy.

Coaxial cable:
Cable that consists of a tubular conductor surrounding a central conductor held in place by insulating material. Used for transmitting high frequency signals.

Computer:
A data processor that can perform substantial computation, including numerous arithmetic or logic operations, without human intervention.

Computer Peripherals:
Any unit of equipment, distinct from the Central Processing Unit, which may provide the system with outside communication.

Computer program:
A series of instructions or statements in a form acceptable to a computer, prepared in order to achieve a specific result. See "Software."

Computer word:
A sequence of bits or characters treated as a unit and capable of being stored in one computer location.

CRT:
See Cathode Ray Tube.

Data processing:
The execution of a systematic sequence of operations performed upon data. Synonymous with information processing.

Dedicated:
Set apart or committed to a definite use (wiring). Addressed to a definite task (signals).

Digital:
Data in the form of discrete digits representing a finite quantity.

Digital computer:
A computer in which discrete representation of data is mainly used. A computer that operates on discrete data by performing arithmetic and logic processes on these data.

Full Duplex Mode:
Pertains to a simultaneous two-way independent transmission in both directions. Contrast with Half Duplex Mode.

General purpose computer:
A computer designed to handle a wide variety of problems.

Half Duplex Mode:
Pertains to an alternate, one way at a time, independent transmission. Contrast with Full Duplex Mode.

Hardware:
Physical equipment, as opposed to the computer program or method of use, e.g., mechanical, magnetic, electrical or electronic devices. Contrast with Software.

Interface:
A shared boundary. An interface might be a hardware component to link two devices or it might be a portion of storage or registers accessed by two or more computer programs.

Magnetic disc:
A flat circular plate with a magnetic surface on which data can be stored by selective magnetization of portions of the flat surface.

Mini-Computer:
A small computer usually incorporating microminiaturization techniques throughout its circuitry, to obtain maximum function in minimum size.

Module:
A packaged, functional unit designed for use with other components.

Operator's console:
An input/output device, including voice intercom, used to communicate with the control system and Central System.

Parity bit:
A check bit appended to an array of binary digits to make the sum of all the digits, including the check bit, always odd or always even.

Real time:
Pertains to the actual time during which a physical process transpires. Also pertains to the performance of a computation during the actual time that the related process transpires, in order that results of the computation can be used in guiding that related process. Usually refers to a computer's ability to automatically interrupt lower priority tasks in process to immediately accomplish higher priority tasks.

Routine:
An ordered set of instructions that may have some general or frequent use.

Scan:
To examine sequentially, part by part or point by point.

Serial Transmission:
In telecommunications, transmission at successive intervals of signal elements constituting the same data signal. The sequential elements may be transmitted with or without interruption, provided that they are not transmitted simultaneously.

Software:
A set of computer programs, procedures, and associated documentation concerned with the operation of a computer e.g., compilers, library routines, manuals, flow charts. Contrast with Hardware.

System response time:
The time period between the change in a monitored condition and the operator notification of such change.

Teletypewriter:
An automatic typewriter that records building automation data as an output, and can be used as an input device to insert instructions, and other data, into the system.

Three mode switching:
Three state switching operations such as fast-slow-stop, summer-winter-auto, day-night-auto, etc.

Two mode switching:
Two state switching operations such as start-stop, on-off, open-close, etc.

what makes the JC/80 system better?

- Simplicity of operator communications.
- Ease of intelligible information retrieval.
- Simplified, reliable installation and commissioning.
- Unlimited expandability, utilizing modular concepts, adds capacity and features at any desirable rate.
- Built-in guarantee against obsolescence. All updates can be incorporated into an existing system as they are developed, thus taking advantage of mini-computer improvements.
- A general purpose communications system compatible with previous digital systems.
- Extreme reliability. Accuracy to within 0.5F. Solid state technology and Johnson's experience with all types of systems pneumatic, electric, electronic, fluidic.
- State-of-the-art electronic technology. Latest concepts appear in integrated circuitry. Modules and field hardware are packaged to accept improvements without obsoleting existing components or circuits.
- Standardized hardware and software. Complete software compatibility across the entire line of computers used in the various system configurations.
- Prompt, reliable service and maintenance, around the clock, anywhere in the world.
- Architectural appeal of the JC/80 System furniture that lends itself to any decor. "Total family" appearance.

computerized building automation systems

PERFORMANCE RECORD

JOHNSON CONTROLS

Computerized Systems Installed or Under Contract

CENTRAL REGION

Johnson Office	Installation	Location
T-6500 Systems		
Indianapolis, IN	*Mead-Johnson	Mount Vernon, IN
JC/80 Central Systems		
Indianapolis, IN	*Cummins Engine	Walesboro, IN
Saginaw, MI	*Michigan Bell Telephone Co.	Saginaw, MI
JC/80 Stand-Alone Systems		
Akron, OH	*University of Akron Performing Arts Center	Akron, OH
Cincinnati, OH	Cincinnati Bell Telephone	Cincinnati, OH
Cincinnati, OH	U.S. Post Office, Bulk Mail Facility	Cincinnati, OH
Cleveland, OH	† Cuyahoga County Justice Center	Cleveland, OH
Cleveland, OH	Parma Hospital	Parma, OH
Columbus, OH	J.C. Penney Catalog & Warehouse Center	Columbus, OH
Dayton, OH	Wright State University	Dayton, OH
Detroit, MI	†*American Motors Headquarters Building	Southfield, MI
Detroit, MI	Crittenton Hospital	Rochester, MI
Detroit, MI	*Detroit Metropolitan Airport	Detroit, MI
Fort Wayne, IN	General Telephone & Electronics	Fort Wayne, IN
Fort Wayne, IN	*Purdue Regional Campus	Fort Wayne, IN
Grand Rapids	*Muskegon Mental Retardation Center	Muskegon, MI
Indianapolis, IN	Adult Hospital	Indianapolis, IN
Indianapolis, IN	Ball State University	Muncie, IN
Indianapolis, IN	Benton Central Schools	Atkinson, IN
Indianapolis, IN	Children's Museum	Indianapolis, IN
Indianapolis, IN	City-County Building	Indianapolis, IN
Indianapolis, IN	Community Hospital	Indianapolis, IN
Indianapolis, IN	Indiana Bell Telephone	Indianapolis, IN
Indianapolis, IN	Indiana University Hospital	Indianapolis, IN
Indianapolis, IN	Western Electric Company	Indianapolis, IN
Louisville, KY	Fair and Exposition Center	Louisville, KY
Louisville, KY	Fayette County Court	Lexington, KY
Saginaw, MI	†*Dow Corning Corporate Center	Midland, MI
South Bend, IN	Elkhart Hospital	Elkhart, IN
Toledo, OH	*Atlas Crankshaft	Fostoria, OH
Youngstown, OH	South Side Hospital	Youngstown, OH
Youngstown, OH	*Youngstown University	Youngstown, OH

*Indicates system is installed.
†Incorporates the ' vision 17 Specification involving multiple systems.

COMPUTERIZED BUILDING AUTOMATION SYSTEMS

JOHNSON CONTROLS

PERFORMANCE RECORD

Computerized Systems Installed or Under Contract

MIDDLE ATLANTIC REGION

Johnson Office	Installation	Location
T-6500 Systems		
Harrisburg, PA	*Hershey Medical Center	Hershey, PA
Harrisburg, PA	*Highway & Safety Building	Harrisburg, PA
Washington, DC	*N.A.S.A.	Greenbelt, MD
JC/80 Central Systems		
Richmond, VA	† United Virginia Bank	Richmond, VA
JC/80 Stand-Alone Systems		
Baltimore, MD	*John Hopkins	Baltimore, MD
Baltimore, MD	U.S. Naval Academy	Annapolis, MD
Charleston, WV	U.S. Post Office	Charleston, WV
Norfolk, VA	Riverside Hospital	Norfolk, VA
Philadelphia, PA	† Philadelphia Art Museum	Philadelphia, PA
Philadelphia, PA	University of Pennsylvania	Philadelphia, PA
Philadelphia, PA	1818 Market Street	Philadelphia, PA
Pittsburgh, PA	*Western Psychiatric Hospital	Pittsburgh, PA
Richmond, VA	*Medical College of Virginia	Richmond, VA
Richmond, VA	J. Sargent Reynolds	Richmond, VA
Roanoke, VA	† Federal Office Building	Roanoke, VA
Roanoke, VA	Washington & Lee University	Roanoke, VA
Washington, DC	*Andrew's Air Force Base	Camp Springs, MD
Washington, DC	Crystal Square	Arlington, VA
Washington, DC	Georgetown University	Washington, DC
Washington, DC	*George Washington University	Washington, DC
Washington, DC	Government Printing Office	Washington, DC
Washington, DC	Japanese Embassy	Washington, DC
Washington, DC	Labor Building	Washington, DC
Process Automation Systems		
(Systems Engineering and Construction Division)		
SECD-E (Philadelphia, PA)	Kennedy Space Center Utilities System Performance Monitoring and Control	Cape Kennedy, FL

*Indicates system is installed.
†Incorporates the Division 17 Specification involving multiple systems.

COMPUTERIZED BUILDING AUTOMATION SYSTEMS

JOHNSON CONTROLS

PERFORMANCE RECORD

Computerized Systems Installed or Under Contract

MIDWESTERN REGION

Johnson Office	Installation	Location
T-6500 Systems		
Chicago, IL	*IBM Office Building	Chicago, IL
Denver, CO	†*Kodak Colorado Division	Windsor, CO
Denver, CO	*Mountain States Telephone Company Champa Building	Denver, CO
Denver, CO	*Mountain States Telephone Company Zuni Street Building	Denver, CO
Madison, WI	*Executive Office Building	Madison, WI
Madison, WI	*Madison General Hospital	Madison, WI
Omaha, NB	*University of Nebraska	Lincoln, NB
JC/80 Central Systems		
Chicago, IL	*Illinois Bell Telephone Company	Chicago, IL
Chicago, IL	*Standard Oil Building	Chicago, IL
Chicago South (Lansing, IL)	*Ingalls Memorial Hospital	Harvey, IL
Milwaukee, WI	*Northwestern Mutual Life Insurance	Milwaukee, WI
Minneapolis, MN	Government Center	Minneapolis, MN
Minneapolis, MN	Univac	Minneapolis, MN
Sioux Falls, SD	South Dakota State University	Brookings, SD
JC/80 Stand-Alone Systems		
Chicago, IL	*Allstate Insurance Building	Northbrook, IL
Chicago, IL	*Chicago Art Institute	Chicago, IL
Chicago, IL	Chicago Field Museum	Chicago, IL
Chicago, IL	Harris Bank	Chicago, IL
Chicago, IL	† Watertower Plaza	Chicago, IL
Chicago, South (Lansing, IL)	Christ Community Hospital	Oak Lawn, IL
Chicago South (Lansing, IL)	Crown Point High School	Crown Point, IN
Chicago South (Lansing, IL)	†*Southlake Mall	Merrillville, IL
Cedar Rapids, IA	*Northwest Bell Telephone	Cedar Rapids, IA
Cedar Rapids, IA	Veterans Administration Hospital	Cedar Rapids, IA
Denver, CO	*St. Joseph's Hospital	Denver, Co.
Des Moines, IA	AEC Laboratory	Ames, IA
Des Moines, IA	*Community College, Area XI	Ankeny, IA
Des Moines, IA	U.S. Post Office, Bulk Mail Facility	Urbandale, IA
Fargo, ND	Basin Electric	Bismarck, ND
Fargo, ND	*Holiday Inn	Bismarck, ND
Fargo, ND	*Northwest Bell Telephone	Fargo, ND
Fargo, ND	*Rehabilitation Hospital	Grand Forks, ND
Fargo, ND	United Hospital	Grand Forks, ND
Madison, WI	Continental Mortgage Insurance Headquarters	Madison, WI
Madison, WI	*First Wisconsin Bank	Madison, WI
Madison, WI	*Mercy Hospital	Janesville, WI
Madison, WI	*WARF Building	Madison, WI

*Indicates system is installed.
†Incorporates the Division 17 Specification involving multiple systems.

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MIDWESTERN REGION (cont'd.)

JC/80 Stand-Alone Systems

Johnson Office	Installation	Location
Milwaukee, WI	Art Center	Milwaukee, WI
Milwaukee, WI	†*First Wisconsin Bank Center	Milwaukee, WI
Milwaukee, WI	*Johnson Controls Corporate Headquarters	Milwaukee, WI
Milwaukee, WI	Milwaukee Area Technical College	Milwaukee, WI
Milwaukee, WI	Mount Sinai Medical Center	Milwaukee, WI
Milwaukee, WI	*Schlitz Brewery	Milwaukee, WI
Milwaukee, WI	St. Mary's Hospital	Milwaukee, WI
Milwaukee, WI	St. Michael's Hospital	Milwaukee, WI
Milwaukee, WI	*Trinity Memorial Hospital	Cudahy, WI
Milwaukee, WI	*Western Printing & Publishing	Racine, WI
Minneapolis, MN	*North High School	Minneapolis, MN
Minneapolis, MN	Northern States Power Co.	Minneapolis, MN
Minneapolis, MN	*St. Cloud State College	St. Cloud, MN
Minneapolis, MN	St. Mary's Hospital	Rochester, MN
Moline, IL	Northwest Bell Telephone	Davenport, IA
Omaha, NB	Creighton Medical Center	Omaha, NB
Omaha, NB	*Immanuel Medical Center	Omaha, NB
Omaha, NB	State Office Building	Lincoln, NB
Peoria, IL	*St. John's Hospital	Springfield, IL
Rockford, IL	†*Cherryvale Mall	Rockford, IL

*Indicates system is installed.
†Incorporates the Division 17 Specification involving multiple systems.

Computerized Systems Installed or Under Contract

NORTHEAST REGION

Johnson Office	Installation	Location
T-6500 Systems		
Hartford, CT	*University of Connecticut Health Center	Hartford, CT
New York, NY	*Belleview Hospital	New York, NY
New York, NY	*Manufacturers' Hanover Trust Bank	New York, NY
New York, NY	*Meadowbrook Hospital	New York, NY
New York, NY	New York Hospital	New York, NY
New York, NY	*Northcentral Bronx Hospital	New York, NY
New York, NY	*Rockefeller Center, Exxon Building	New York, NY
New York, NY	*Rockefeller Center, McGraw-Hill Building	New York, NY
New York, NY	*West Point Military Academy	West Point, NY
JC/80 Central Systems		
Boston, MA	Boston City Hospital	Boston, MA
Boston, MA	Federal Office Building	Manchester, NH
New York, NY	New York Life Insurance	New York, NY
Union, NJ	New Jersey College of Medicine	Newark, NJ
JC/80 Stand-Alone Systems		
Albany, NY	St. Claire's Hospital	Albany, NY
Boston, MA	Beth Israel Hospital	Boston, MA
Boston, MA	Blue Cross/Blue Shield Building	Boston, MA
Boston, MA	Campus School	Boston, MA
Boston, MA	*City Hall	Boston, MA
Boston, MA	*English High School	Boston, MA
Boston, MA	Grover Cleveland School	Boston, MA
Boston, MA	*Lowell Technological Institute Chemistry-Science Building	Lowell, MA
Boston, MA	National Shawmut Bank	Boston, MA
Boston, MA	St. John's Hospital	Lowell, MA
Boston, MA	University of Massachusetts Medical School	Worcester, MA
Boston, MA	U.S. Post Office Complex	Manchester, NH
Buffalo, NY	Buffalo City Court	Buffalo, NY
Buffalo, NY	Kenmore Mercy Hospital	Buffalo, NY
Hartford, CT	New Britain Hospital	New Britain, CT
New Haven, CT	*St. Vincent's Hospital	New Haven, CT
New York, NY	Columbia University, Agustus Long Library	New York, NY
New York, NY	Columbia University Gymnasium	New York, NY
New York, NY	Downstate Medical Center	New York, NY
New York, NY	Foley Square, Center I	New York, NY
New York, NY	Foley Square, Center II	New York, NY
New York, NY	General Post Office	New York, NY
New York, NY	Lincoln Hospital	New York, NY
New York, NY	Nassau Hospital	New York, NY

*Indicates system is installed

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NORTHEAST REGION (cont'd.)

Johnson Office	Installation	Location
JC/80 Stand Alone Systems		
New York, NY	*Northern Westchester Hospital	New York, NY
New York, NY	Rockefeller Center, Celanese Building	New York, NY
New York, NY	Rockefeller Center, Building #12	New York, NY
New York, NY	Rockefeller Center, Building #17	New York, NY
New York, NY	South Nassau Community Hospital	New York, NY
New York, NY	Suffolk State School	Melville, LI, NY
Rochester, NY	Eastman Kodak	Rochester, NY
Rochester, NY	First Federal Plaza	Rochester, NY
Rochester, NY	*Lincoln Towers Office Building	Rochester, NY
Rochester, NY	Rochester Institute of Technology	Rochester, NY
Springfield, MA	Mercy Hospital	Springfield, MA
Syracuse, NY	Harpur College	Vestal, NY
Union, NJ	Beth Israel Hospital	Newark, NJ
Union, NJ	PATH Bus Terminal	Union, NJ
Union, NJ	St. Francis Health Center	Union, NJ

*Indicates system is installed.

COMPUTERIZED BUILDING AUTOMATION SYSTEMS

JOHNSON CONTROLS

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PERFORMANCE RECORD

Computerized Systems Installed or Under Contract

PACIFIC COAST REGION

Johnson Office	Installation	Location
T-6500 Systems		
Los Angeles, CA	*Atlantic Richfield Towers	Los Angeles, CA
Los Angeles, CA	*North American Rockwell Autonetics Division	Niguel, CA
San Diego, CA	*NCR Building	Rancho Bernardo, CA
San Diego, CA	*University of California, San Diego Campus	San Diego, CA
San Francisco, CA	*Bank of America	San Francisco, CA
San Francisco, CA	*Fireman's Fund Building	San Francisco, CA
San Francisco, CA	*Fresno Community Hospital	Fresno, CA
Seattle, WA	*University of Washington	Seattle, WA
JC/80 Stand-Alone Systems		
Great Falls, MT	Northern Montana Hospital	Havre, MT
Great Falls, MT	U.S. Post Office	Billings, MT
Los Angeles, CA	*California Institute of Technology	Pasadena, CA
Los Angeles, CA	Federal Office Building	Santa Anna, CA
Los Angeles, CA	Federal Office Building	Van Nuys, CA
Los Angeles, CA	Kaiser Hospital	Los Angeles, CA
Los Angeles, CA	*St. Mary's Medical Center	Long Beach, CA
Los Angeles, CA	*University of California at Santa Barbara	Santa Barbara, CA
Los Angeles, CA	*U.S. Naval Hospital	Long Beach, CA
Phoenix, AZ	*Federal Office Building	Tucson, AZ
Phoenix, AZ	*Maricopa County Community College Glendale Campus	Phoenix, AZ
Phoenix, AZ	*Maricopa County Community College Maricopa Technical Campus	Phoenix, AZ
Phoenix, AZ	*Maricopa County Community College Mesa Campus	Phoenix, AZ
Phoenix, AZ	*Maricopa County Community College Phoenix Campus	Phoenix, AZ
Phoenix, AZ	Pima Courts Building	Tucson, AZ
Portland, OR	† Evans Products Building	Portland, OR
Portland, OR	Good Samaritan Hospital	Corvallis, OR
Portland, OR	Portland Airport	Portland, OR
Portland, OR	*Sacred Heart Hospital	Eugene, OR
Salt Lake City, UT	Bingham High School	Bingham, UT
Salt Lake City, UT	*Brigham Young University	Provo, UT
Salt Lake City, UT	*Idaho Falls Temple	Idaho Falls, ID
San Diego, CA	Kaiser Hospital	San Diego, CA
San Diego, CA	*University Hospital	San Diego, CA
San Francisco, CA	*Metropolitan Life Insurance	San Francisco, CA
San Francisco, CA	Pacific Telephone & Telegraph	Fresno, CA
San Francisco, CA	St. Agnes Hospital	Fresno, CA
San Francisco, CA	† Standard Oil Building	San Francisco, CA
San Francisco, CA	U.S. Post Office, Bulk Mail Facility	Richmond, CA
San Francisco, CA	Valley Medical Center	Fresno, CA
Seattle, WA	U.S. Post Office, Bulk Mail Facility	Seattle, WA

*Indicates system is installed.
†Incorporates the Division 17 Specification involving multiple systems.

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PACIFIC COAST REGION (cont'd.)

Process Automation Systems

(Systems Engineering and Construction Division)

Johnson Office	Installation	Location
SECD-W (Los Angeles, CA)	*American Oil Company Refinery Automation Performance Monitoring	Salt Lake City, UT
SECD-W (Los Angeles, CA)	City of Los Angeles Hyperion Sewage Treatment Plant Direct Digital Control	Los Angeles, CA
SECD-W (Los Angeles, CA)	City of Los Angeles Terminal Island Sewage Treatment Plant Direct Digital Control	Los Angeles, CA
SECD-W (Los Angeles, CA)	*San Bernardino Municipal Water District Water Pipeline Direct Digital Control	San Bernardino, CA

*Indicates system is installed.

COMPUTERIZED BUILDING AUTOMATION SYSTEMS

JOHNSON CONTROLS

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Computerized Systems Installed or Under Contract

SOUTHEAST REGION

Johnson Office	Installation	Location
T-6500 Systems		
Memphis, TN	*Memphis State University	Memphis, TN
Miami, FL	*Dade County Junior College	Miami, FL
JC/80 Central Systems		
Albany, GA	Warner Robbins Air Force Base	Macon, GA
Atlanta, GA	Emory University Hospital	Atlanta, GA
Knoxville, TN	East Tennessee State University	Johnson City, TN
Knoxville, TN	TVA Office Building	Knoxville, TN
Memphis, TN	Memphis Airport	Memphis, TN
Memphis, TN	*Methodist Hospital	Memphis, TN
JC/80 Stand-Alone Systems		
Atlanta, GA	*Georgia State University	Atlanta, GA
Atlanta, GA	U.S. Post Office, Bulk Mail Facility	Atlanta, GA
Birmingham, AL	Von Braun Civic Center	Huntsville, AL
Columbia, SC	*Baptist Hospital	Columbia, SC
Columbia, SC	North Trident Regional Hospital, HCA	Charleston, SC
Greensboro, NC	Burlington Industries	Stokesdale, NC
Greensboro, NC	Hall of Justice	Winston-Salem, NC
Greensboro, NC	U.S. Post Office, Bulk Mail Facility	Greensboro, NC
Greenville, SC	St. Joseph's Hospital	Ashville, NC
Jackson, MS	Deposit Guaranty National Bank	Jackson, MS
Jacksonville, FL	Florida State University	Gainesville, FL
Jacksonville, FL	*State Capitol Building	Tallahassee, FL
Knoxville, TN	Holston Valley Community Hospital	Kingsport, TN
Memphis, TN	Jackson-Madison County Hospital	Jackson, TN
Memphis, TN	St. Jude's Hospital	Memphis, TN
Memphis, TN	U.S. Post Office, Bulk Mail Facility	Memphis, TN
Mobile, AL	West Florida Hospital, HCA (Ferry Pass)	Pensacola, FL
Nashville, TN	Veterans Administration Hospital	Nashville, TN
Tampa, FL	General Telephone	Clearwater, FL
Tampa, FL	General Telephone	St. Petersburg, FL
Tampa, FL	Mental Health Facility	Tampa, FL
Tampa, FL	Tampa Tribune	Tampa, FL

*Indicates system is installed.

Computerized Systems Installed or Under Contract

SOUTHWEST REGION

Johnson Office	Installation	Location
T-6500 Systems		
Austin, TX	*University of Texas at Austin	Austin, TX
Lubbock, TX	*Texas Tech University	Lubbock, TX
Oklahoma City, OK	*Oklahoma University	Oklahoma City, OK
Oklahoma City, OK	*Thermal Systems, Inc.	Oklahoma City, OK
Kansas City, MO	*State Capitol Complex	Topeka, KS
JC/80 Central Systems		
Dallas, TX	University of Texas at Dallas	Dallas, TX
San Antonio, TX	Southwestern Bell Telephone, #2 Toll	San Antonio, TX
San Antonio, TX	University of Texas at San Antonio	San Antonio, TX
St. Louis, MO	St. Louis Convention Center	St. Louis, MO
Tulsa, OK	St. John's Hospital, Power & Main	Tulsa, OK
JC/80 Stand-Alone Systems		
Albuquerque, NM	*Mountain Bell Telephone (Dillards)	Albuquerque, NM
Albuquerque, NM	*University of New Mexico Cancer Research Building	Albuquerque, NM
Austin, TX	*Southwestern Bell Telephone Co.	Austin, TX
Baton Rouge, LA	Coates Laboratory	Baton Rouge, LA
Baton Rouge, LA	Louisiana State School for the Deaf	Baton Rouge, LA
Dallas, TX	*Plano Hospital, HCA	Plano, TX
Dallas, TX	Sun Services (Sun Oil Company)	Dallas, TX
Dallas, TX	*U.S. Post Office, Bulk Mail Facility	Dallas, TX
Houston, TX	Fluor Corporation Building	Houston, TX
Houston, TX	†*Houston Center Two	Houston, TX
Houston, TX	University of Texas Medical School	Houston, TX
Kansas City, MO	Kansas City Convention Center	Kansas City, MO
Kansas City, MO	Menorah Hospital	Kansas City, MO
Little Rock, AR	*National Center for Toxological Research	Pine Bluff, AR
Lubbock, TX	Big Springs Hospital, HCA	Big Springs, TX
Oklahoma City, OK	*National Foundation Center	Oklahoma City, OK
Oklahoma City, OK	*State Capitol Complex	Oklahoma City, OK
San Antonio, TX	*Frost Bank	San Antonio, TX
San Antonio, TX	University of Texas at San Antonio Dental School	San Antonio, TX
St. Louis, MO	Southern Illinois University	Edwordsville, IL
Tulsa, OK	*Gardner-Denver, Plant #11	Pryor, OK

*Indicates system is installed.
†Incorporates the Division 17 Specification involving multiple systems.

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SOUTHWEST REGION (cont'd.)

Process Automation Systems

(Systems Engineering and Construction Division)

Johnson Office	Installation	Location
SECD-SW (Dallas, TX)	City of Dallas Water Distribution System Performance Monitoring	Dallas, TX
SECD-SW (Dallas, TX)	City of Milwaukee South Shore Waste Water Treatment Plant Direct Digital Control	Milwaukee, WI
SECD-SW (Dallas, TX)	*Dallas/Ft. Worth Airport Central Utilities Plant Performance Monitoring and Control	Dallas, TX
SECD-SW (Dallas, TX)	Joseph Schlitz Brewing Co. Brewery Plant Performance Monitoring and Control	Longview, TX
SECD-SW (Dallas, TX)	*Kelly Air Force Base Waste Incinerator Blending Direct Digital Control	San Antonio, TX
SECD-SW (Dallas, TX)	*Texas Industries Ready Mix Concrete Automatic Batch Truck Scheduling and Dispatch	Dallas, TX
SECD-SW (Dallas, TX)	*University of Texas at Dallas Central Energy Plant Performance Monitoring and Billing	Dallas, TX
SECD-SW (Dallas, TX)	*University of Texas at Odessa Central Energy Plant Performance Monitoring and Billing	Odessa, TX
SECD-SW (Dallas, TX)	*University of Texas at San Antonio Central Energy Plant Performance Monitoring and Billing	San Antonio, TX
SECD-SW (Dallas, TX)	Wisconsin Electric Power Company Generating Plant Consolidation/Modernization Performance Monitoring	Oak Creek, WI

*Indicates system is installed.

Computerized Systems Installed or Under Contract

CANADA

Johnson Office	Installation	Location
T-6500 Systems		
Hamilton, Ont.	*Guelph University	Guelph, Ont.
Hamilton, Ont.	*McMaster University	Hamilton, Ont.
Montreal, Que.	*Place Radio Canada (CBC)	Montreal, Que.
Ottawa, Ont.	*University of Ottawa	Ottawa, Ont.
Toronto, Ont.	*Kodak	Brampton, Ont.
Toronto, Ont.	*Toronto International Airport	Toronto, Ont.
Toronto, Ont.	*University of Toronto	Toronto, Ont.
JC/80 Central Systems		
Halifax, N.S.	Scotia Square	Halifax, N.S.
London, Ont.	University of Western Ontario	London, Ont.
Montreal, Que.	*Route Transcanadienne	Montreal, Que.
JC/80 Stand-Alone Systems		
Edmonton, Al.	*Edmonton Centre	Edmonton, Al.
Halifax, N.S.	Western Memorial Hospital	Corner Brook, Nfld.
Montreal, Que.	Institute de Cardiologie	Montreal, Que.
Montreal, Que.	† Museum of Fine Arts	Montreal, Que.
Ottawa, Ont.	Bank of Canada	Ottawa, Ont.
Ottawa, Ont.	*Campeau Place de Ville	Ottawa, Ont.
Ottawa, Ont.	Metropolitan Life Insurance	Ottawa, Ont.
Ottawa, Ont.	Twin Towers	Ottawa, Ont.
Regina, Sask.	*Saskatchewan Telephone Company	Regina, Sask.
Toronto, Ont.	Guardian Royal Exchange Towers	Toronto, Ont.
Toronto, Ont.	*MAPP	Toronto, Ont.
Toronto, Ont.	*Sunneybrook Hospital	Toronto, Ont.
Tororito, Ont.	TABS Network	Toronto, Ont.
Toronto, Ont.	*Toronto Dominion Centre-TWR #1 & #2	Toronto, Ont.
Toronto, Ont.	*Toronto Dominion – TWR #3	Toronto, Ont.
Toronto, Ont.	*Workman's Compensation Board	Toronto, Ont.
Toronto, Ont.	York County Hospital	Toronto, Ont.
Toronto, Ont.	*2 Bloor Street East	Toronto, Ont.
Vancouver, B.C.	Workman's Compensation Board	Vancouver, B.C.
Winnipeg, Man.	405 Broadway	Winnipeg, Man.
Process Automation Systems		
(Systems Engineering and Construction Division)		
SECD-Canada (Toronto, Ont.)	Ashbridge's Bay Sewage Treatment Plant	Toronto, Ont.

*Indicates system is installed.
†Incorporates the Division 17 Specification involving multiple systems.

COMPUTERIZED BUILDING AUTOMATION SYSTEMS

JOHNSON CONTROLS

PERFORMANCE RECORD

Computerized Systems Installed or Under Contract

INTERNATIONAL

Johnson Office	Installation	Location	Type of System
Africa			
Cape Town, S.A.	Civic Centre	Cape Town	JC/80 S.A.
Durban, S.A.	Bay Passage Investments	Durban	JC/80 S.A.
Johannesburg, S.A.	Barclays Bank	Johannesburg	JC/80 S.A.
Johannesburg, S.A.	Escom Headquarters Building	Johannesburg	JC/80 S.A.
Johannesburg, S.A.	Jan Smuts Airport Cabin Service	Johannesburg	JC/80 S.A.
Johannesburg, S.A.	Rand Afrikaans University	Johannesburg	JC/80 S.A.
Johannesburg, S.A.	South Africa Broadcasting Corp.	Johannesburg	JC/80 C.S.
Australia			
Melbourne	Commonwealth Bank Building	Melbourne	JC/80 S.A.
Melbourne	Windsor Telephone Exchange	Melbourne	JC/80 S.A.
Sydney	Bradfield Park C.S.I.R.O. Laboratories	Sydney	JC/80 S.A.
Sydney	Comalco House	Brisbane	JC/80 C.S.
Sydney	King & George Sts. Office Building	Sydney	JC/80 S.A.
Sydney	*Qantas	Sydney	T-6500
Sydney	Royal North Shore Hospital	Sydney	JC/80 S.A.
Sydney	State Govt. Insurance Office	Brisbane	JC/80 C.S.
Sydney	St. Andrew's, C. of E. Complex	Sydney	JC/80 S.A.
Sydney	St. James Office Building	Sydney	JC/80 S.A.
Sydney	Totalizer Agency Board State H.O.	Brisbane	JC/80 S.A.
Belgium			
Brussels	*Gouvernements Hotel	Antwerp	JC/80 S.A.
Brussels	*Societe Generale de Banque Brussels	Brussels	JC/80 C.S.
Brussels	Tour Astro	Brussels	JC/80 S.A.
Brussels	*University of Brussels	Brussels	JC/80 S.A.
Denmark			
GEWA Controls (Distributor)	A.T.P. Huset	Copenhagen	JC/80 S.A.
France			
Paris	Renault	Paris	JC/80 S.A.
Paris	*Rive de Seine	Paris	JC/80 S.A.
Paris	*U.A.P. Courbevoie la Defense	Paris	JC/80 C.S.
Germany			
Frankfurt	*3M Deutschland GmbH	Neuss, W.G.	JC/80 S.A.
Hamburg	Druckerei Broscheck	Hamburg, W.G.	JC/80 S.A.
Hong Kong			
Hong Kong	† Gammon House	Hong Kong	JC/80 S.A.
Hong Kong	Hung Hom Railway Terminal	Hong Kong	JC/80 S.A.

*Indicates system is installed.
†Incorporates the Division 17 Specification involving multiple systems.

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INTERNATIONAL (cont'd.)

Johnson Office	Installation	Location	Type of System
Italy			
Milan	Boehringer Offices and Plant	Monza	JC/80 S.A.
Milan	I.N.A.I.L. Office Building	Milan	JC/80 S.A.
Rome	AGIP Headquarters Building	Rome	JC/80 S.A.
Japan			
Fukuoka	Honda Motor-Kumamoto	Kumamoto	JC/80 S.A.
Hokkaido	Hokkaido Press	Sapporo	JC/80 S.A.
Tohoku	Yamagata Prefecture Building	Yamagata	JC/80 S.A.
Tokyo	Denki Building	Tokyo	JC/80 S.A.
Tokyo	*Korakuen Ice Palace	Tokyo	JC/80 S.A.
Tokyo	Kosei Hospital	Tokyo	JC/80 S.A.
Tokyo	Seibushinjuku St. Building	Tokyo	JC/80 C.S.
Mexico			
Mexico City	*I.S.S.S.T.E. Hospital	Mexico City	JC/80 S.A.
Singapore			
Mechanical Systems (S) Pte. Ltd. (Distributor)	Central Provident Fund	Singapore	JC/80 S.A.
	Overseas Chinese Bank	Singapore	JC/80 S.A.
	*Plaza Singapura	Singapore	JC/80 S.A.
Spain			
Tecnicontrol, S.A. (Distributor)	*Campsa	Madrid	JC/80 S.A.
	Protechnica	Madrid	JC/80 S.A.
	Telefonica	Madrid	JC/80 S.A.
	Traingulo Princesa	Madrid	JC/80 S.A.
Switzerland			
Geneva	*Bureau International du Travail, BIT	Geneva	JC/80 S.A.
Geneva	*Societe de Banque Suisse, SBS	Geneva	JC/80 S.A.
Zurich	*Kaufmannischer Verein, KVZ	Zurich	JC/80 S.A.
United Kingdom			
Glasgow	Scottish Widows' Fund	Edinburgh	JC/80 S.A.
Leatherhead	Sedgwick Collins Bldg.	London	JC/80 S.A.
London	B.P. Victoria Street	London	JC/80 S.A.
London	Clements Inn	London	JC/80 S.A.
London	Hounslow Civic Centre	London	JC/80 S.A.
London	London Bridge Development	London	JC/80 S.A.
London	National Westminster Bank	Bishopsgate	JC/80 C.S.
Manchester	Eldon Square Development	Newcastle	JC/80 S.A.

JC/80 C.S. = Central System
JC/80 S.A. = Stand-Alone System

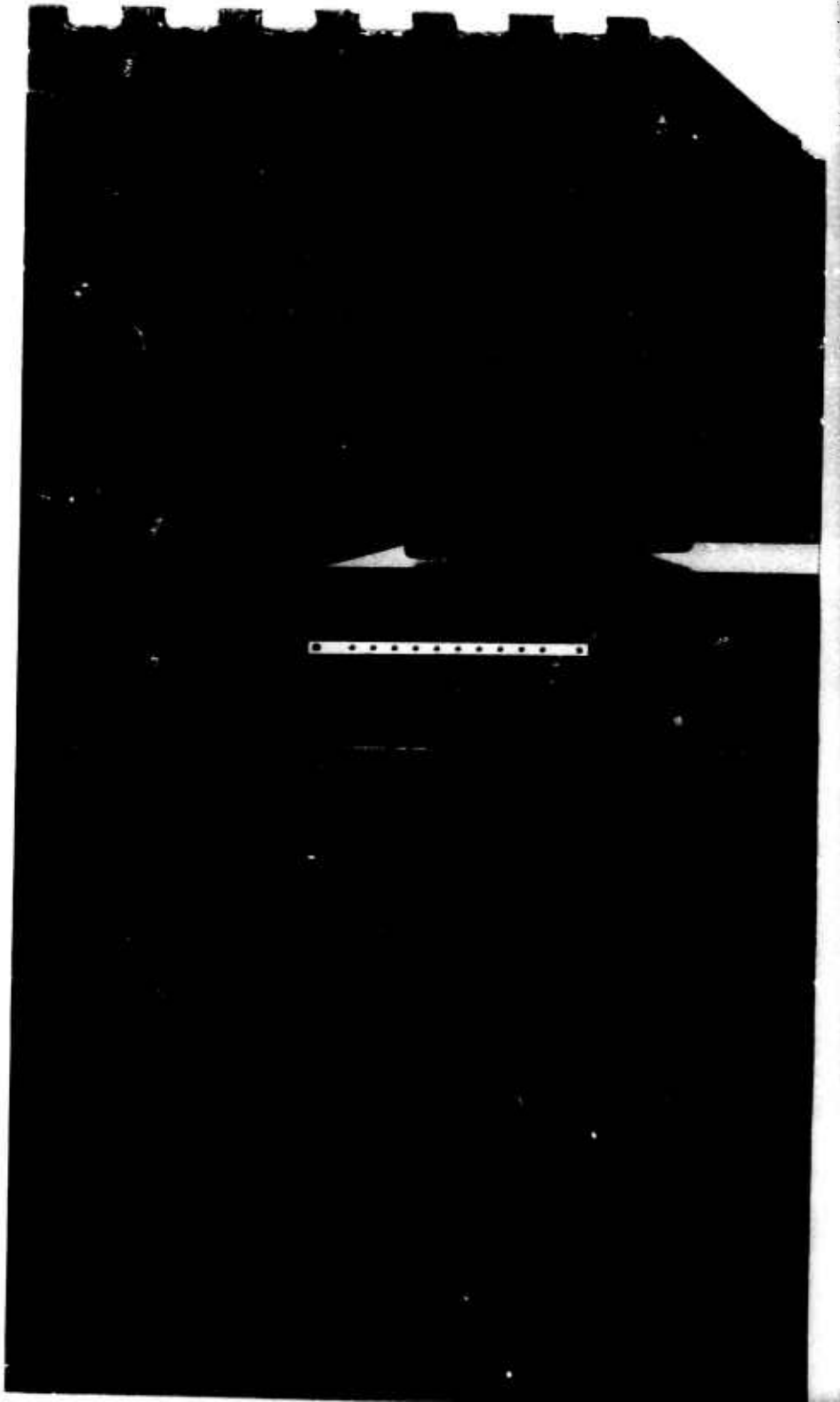
*Indicates system is installed.

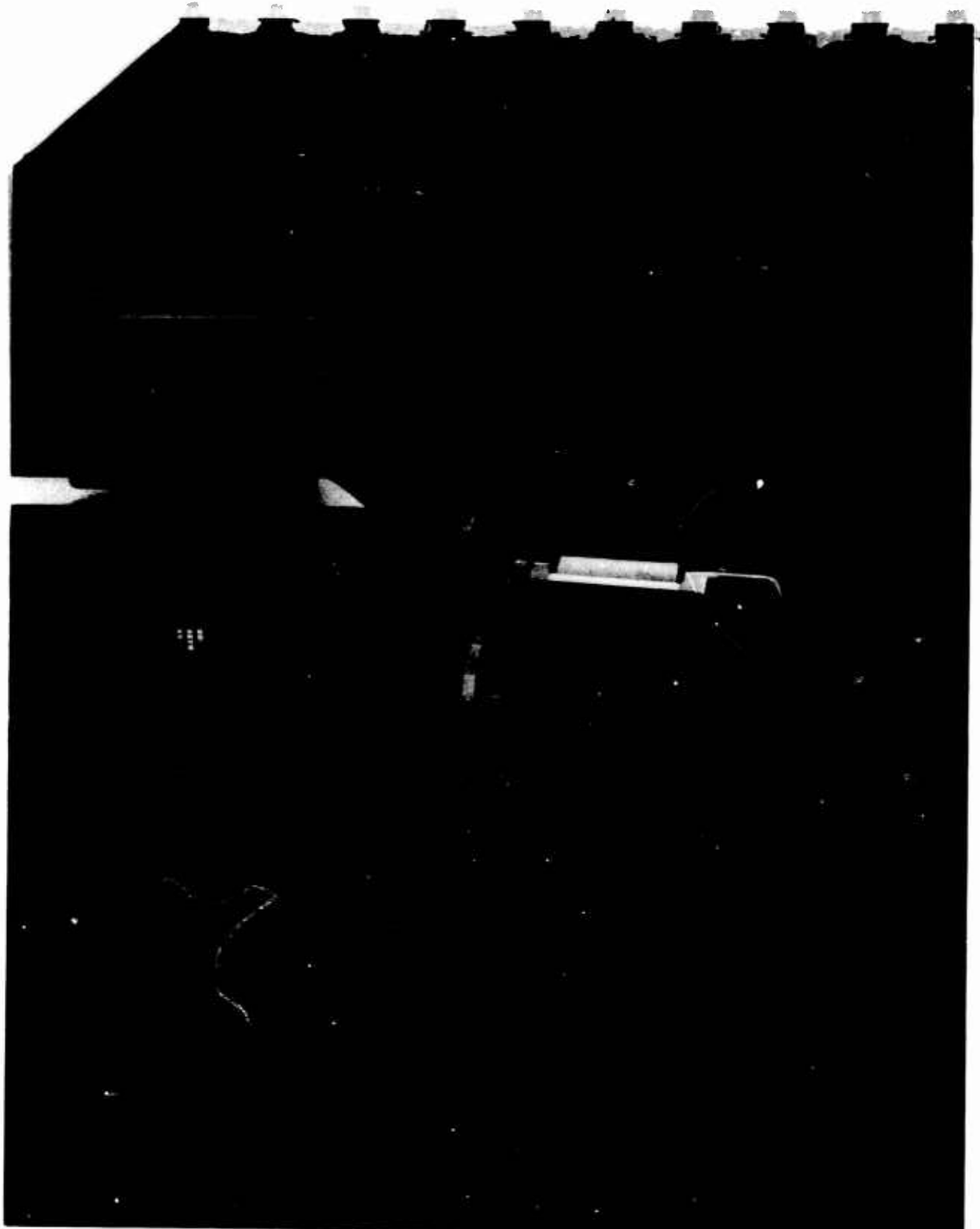
ECON VI

the untiring building manager...

Operating 24 hours a day to conserve energy by managing:

- Heating/cooling systems
- Energy & power
- Human life safety
- Building security
- People Comfort





...that more than pays its own way

Your building, operating at peak efficiency — as it was designed to operate — is a realistic way to experience real savings in building management. ECON VI, the untiring building manager, pays for itself 24 hours a day by cutting costs, improving manpower utilization and extending equipment life.

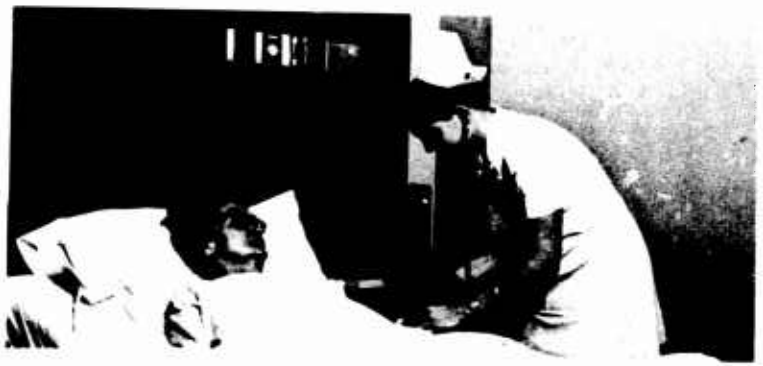
You are guaranteed a return on your investment with dividends you can see every day. ECON VI is a total Building Systems Manager with a real payback.

total building systems management

unlimited systems capability

ECON VI has virtually unlimited capability to gather, process and control building systems data. It will manage all facets of your building, large or small, new or existing. Controlling building comfort, area lighting, entry protection, life safety, energy costs, routine maintenance and preventive maintenance, as well as a host of other functions are "naturals" for ECON VI. It manages an entire building or complex of buildings as one total system. Growth capability to satisfy your requirements for tomorrow's expansion has been designed into ECON VI.

This entirely new concept of Building Systems Management effectively incorporates the latest state of the art electronics and two wire data transmission.



greater operating efficiency . . .
. . . lower operating costs

ECON VI can provide greater comfort, conserve energy, lower building operating costs, minimize system component breakdowns, optimize system efficiency, provide surveillance and security force backup, program routine maintenance, provide fire detection and alarm, and alert personnel to perform preventive maintenance. The result is a finely tuned building system with an added plus — greater operating efficiency and lower operating costs.

comfort assurance

Occupant comfort is the foremost consideration of any building owner, operator, or designer, as it must be. You can be confident that ECON VI will keep your occupants comfortable and, in addition, provide you with operating cost savings.

energy conservation

The need for energy conservation through building system optimization is a reality today. No longer can building systems be operated at any cost or with excessive equipment; equipment operating efficiency must be maximized. ECON VI conserves energy and lowers your operating budget.

the building manager that more than pays its own way

save energy and manpower

A building of any size operating efficiently and saving money is within your grasp. Consider ECON VI, a centralized control system that manages your entire building while saving money. In fact, ECON VI will pay for itself in a few short years. Start saving through more efficient use of energy and manpower.

ECON VI is an investment with a real payback. When you buy an ECON VI, you buy the capability of the entire Barber-Colman organization. Our personnel give you the personal attention unequaled anywhere else.

programmed efficiency

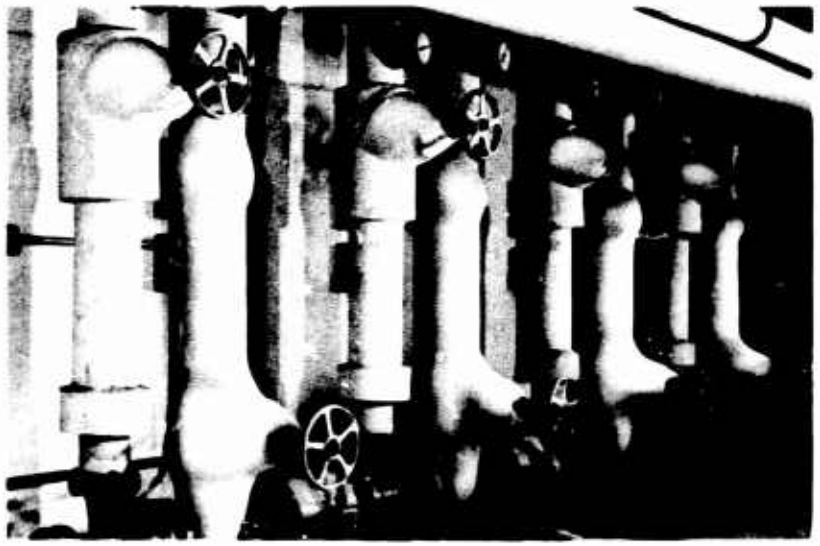
Time consuming functions, such as routine startup and shutdown, monitoring temperatures, pressures, turning lights on and off, as well as a multitude of other tasks can be accomplished automatically by ECON VI. Your maintenance crew need not physically tour the entire building checking individual areas, floors and mechanical equipment. Costly emergency service is drastically reduced through programmed preventive maintenance.

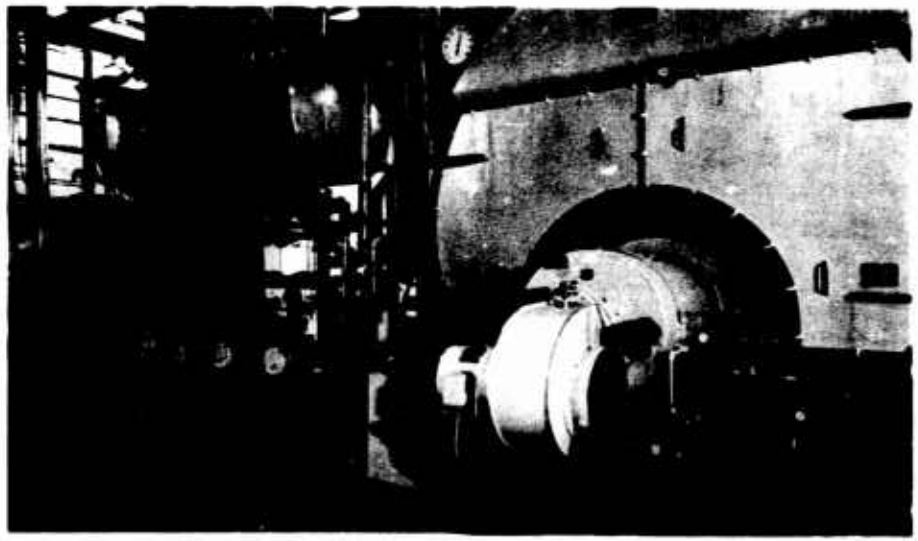
round-the-clock optimization

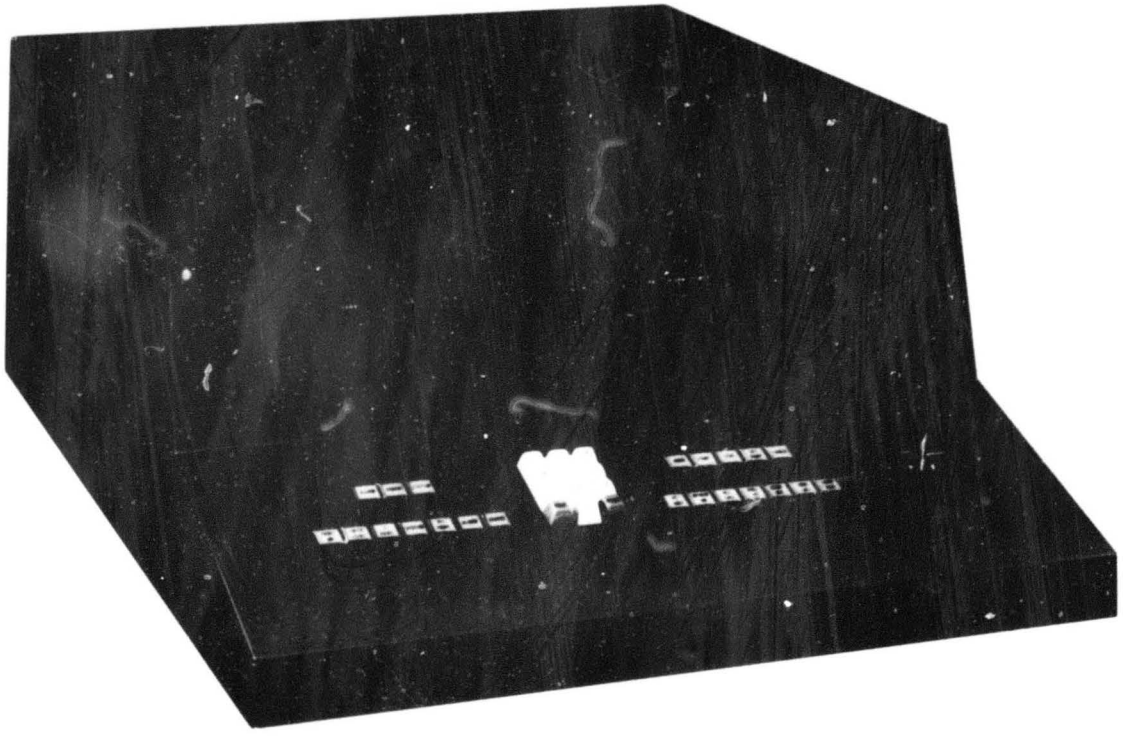
Through 24-hour building management, ECON VI offers real savings through optimum system performance. Typically, a 10 to 30% cost reduction can be realized annually in maintenance, operation, emergency service, fuel and electrical billings.

experience real savings with ECON VI:

- Minimize emergency calls through central system monitoring
- Instant reports of equipment malfunctions and abnormal conditions.
- Minimize time spent walking, observing, and recording by using the central console
- Improve operating efficiency through central recording and evaluation of records to construct trends
- Prolong equipment life with preventive maintenance scheduling
- Obtain instant spot checks on temperatures and equipment modes of operation from central control console
- Optimize cooling and reheating through monitoring outside air temp and adjusting dampers
- Reducing electrical demand
- Reduce maintenance manhours with informative equipment displays and audio communications
- Reduce readjustment and switching with central control
- Control lights in unoccupied areas with surveillance at central console
- Instant pinpointing of failures from one location
- Reduce manpower hours with automatic start/stop programs
- Decrease insurance programs by monitoring fire and security systems
- Minimize maintenance time through routine equipment service scheduling.







modular flexibility

ECON VI was designed with a broad spectrum of buildings in mind. Through the use of standard modules, ECON VI can be tailored to your building management objectives. You don't have to buy a sophisticated automation system with equipment you don't require. As system complexity increases, ECON VI can grow with you, while maintaining simplicity of operation.

heart of the system

The heart of the ECON VI Building Management System is the Basic Operator's Console. It is the nerve center that organizes your entire building to save you time and money. It is small enough to fit on a building operating engineer's desk. Yet, as small as it is, it provides:

- Contact Alarm Annunciation
- Analog Indication
- Digital Setpoint Control
- Automatic Equipment Monitoring
- Two-wire Data Transmission
- Visual System and Point Monitoring
- Less Than 1 Second Response Time
- Unlimited Expansion Capability.

operational simplicity

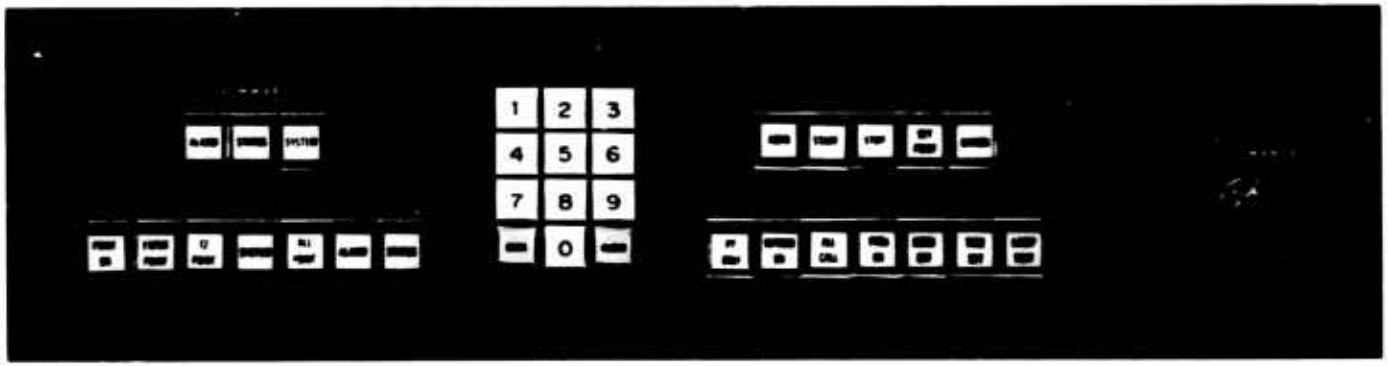
ECON VI, from the Basic Operator's Console to the fully automated system employing a dedicated mini-computer, was designed for simplicity of operation. Since a minimum of technical knowledge is required of the operator, your existing personnel can fully utilize its capability.

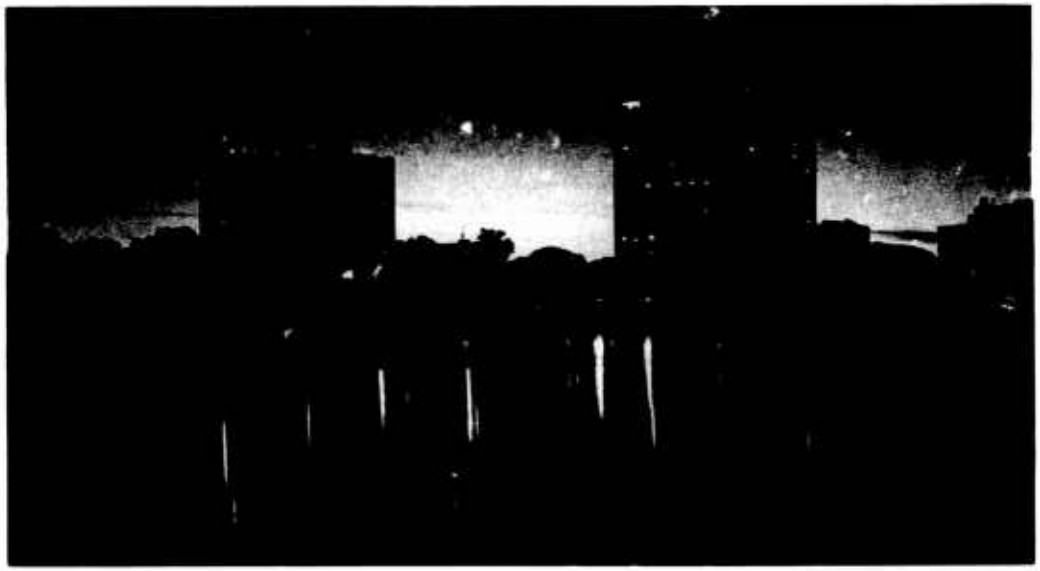
visual display

Basic Operator's Console Display. The ECON VI display offers you the opportunity to visually monitor building systems by observing normal and alarm conditions.

system access

Basic Operator's Console Keyboard. The ECON VI keyboard enables you to control building systems — start fans, turn off motors, reset temperatures, and so on — to obtain a comfortable environment and maximize equipment efficiency. Your building Operating Engineer maximizes system performance without leaving the console.





ECON VI grows with you

a planned beginning . . . .

The modular design of ECON VI provides a practical and economical approach to Building Systems Management. Our building management engineers, working with consulting engineers, architects and owners coordinate the parameters of the Building Systems Management functions. Only then is specific equipment selected to manage the building efficiently. The system you select precisely matches the requirements of your specific building. You do not buy auxiliary equipment that remains unused and adds to first costs and operating inefficiency. Yet ECON VI will meet your most sophisticated requirements.

. . . . and modular expansion

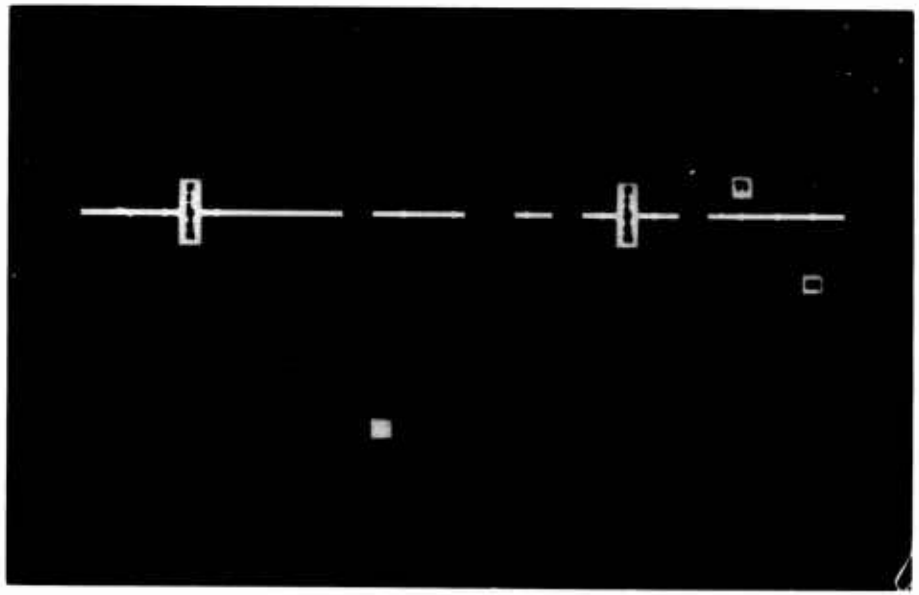
When your systems become more complex, ECON VI has the expansion capability to meet that need economically. You don't have to start over by buying a completely new Building Management System . . . you merely add-on to your present automation system, utilizing standard plug-in modules.

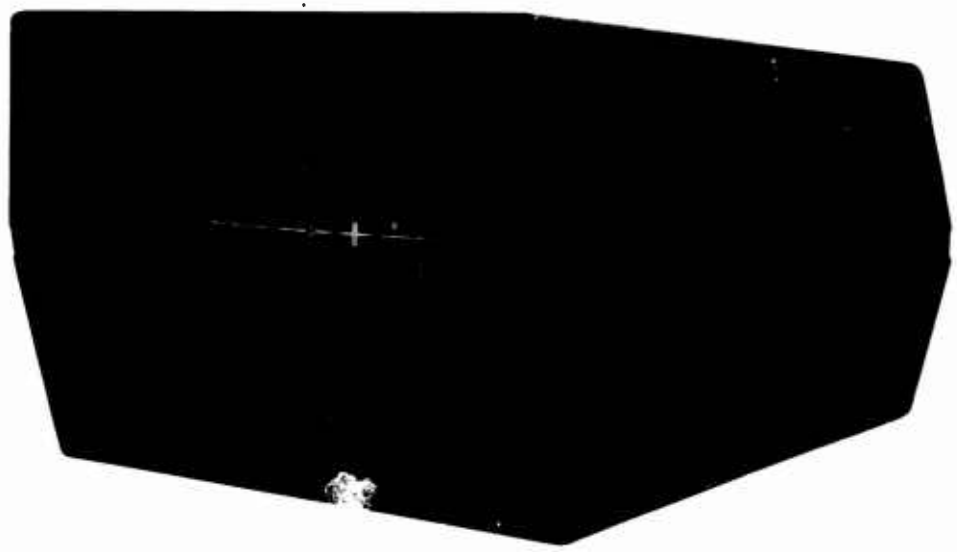
audio communications

Audio monitoring of remote systems and equipment, including multistation tone paging and remote call-in capability.

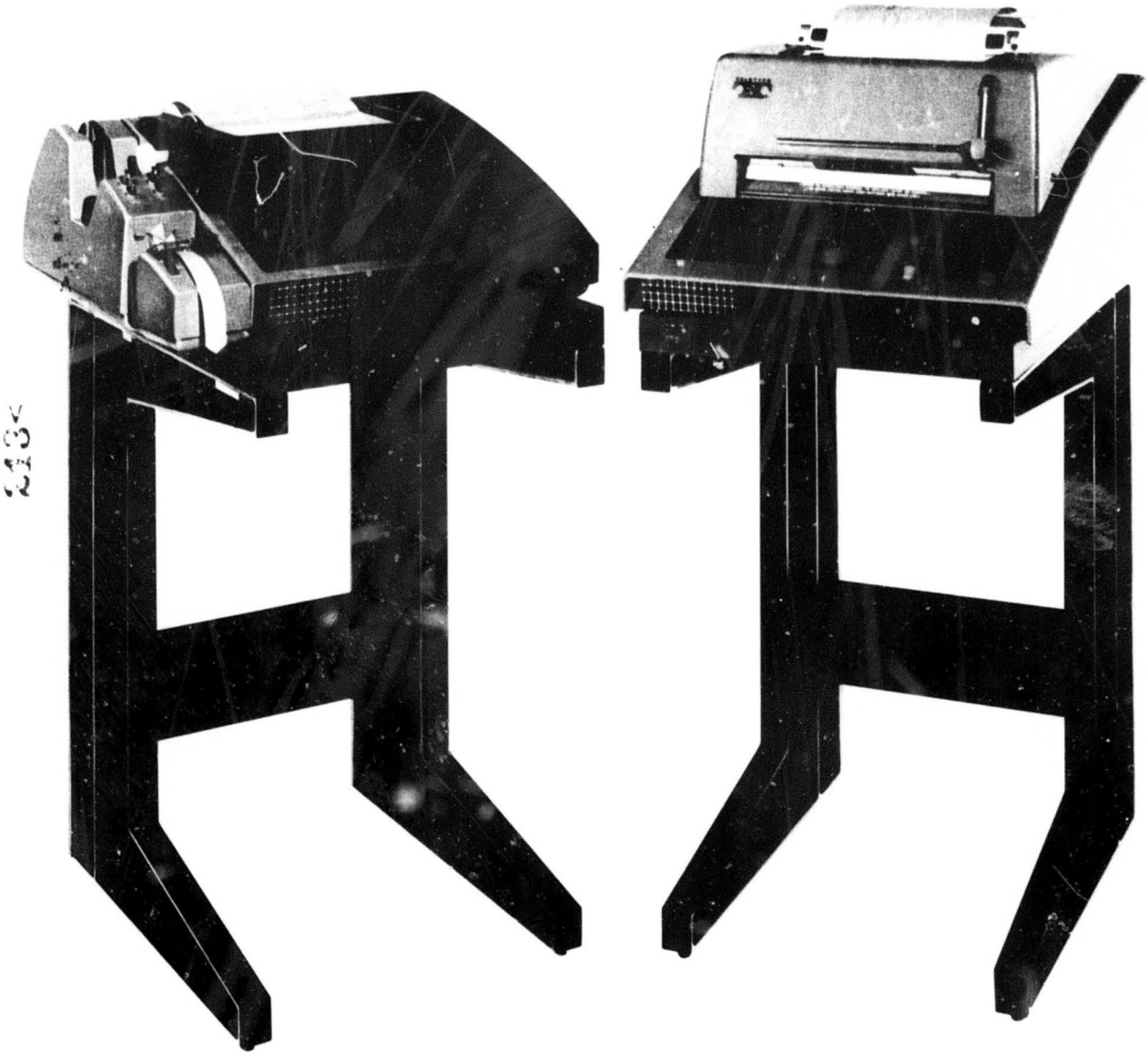
visual display

Provides full-color graphic displays of control building systems configurations, identifying specific systems, points and locations, and has automatic indexing on alarm.





organized expansion without complexity



The level of central automation sophistication is determined by your requirements for Building Systems Management. Sophistication does not necessarily mean complexity. Human engineering was a primary consideration during the design and development phases of ECON VI. ECON VI keeps the operator in mind with designed-in simplicity of operation.

printed system records

Teletype printers provide records of building data for analysis and forecasts. These printers provide clear, concise printouts of alarm summaries, status summaries, system summaries, multiple point trends, system trends and all point logs. Add one or more printers to the central console or to remote locations. Remote printers can provide your personnel with life safety and security information for more effective control.

RO-33 printer

This model receives and prints data. All logs are printed in black at a rate of 10 characters per second.

RO-35 printer

Similar to Model RO-33 with alarm printouts in red.

10:14 TREND LOG INTERVAL: 010 MINUTES

	1	01 001 34	HTDK	85.2								
	2	01 002 34	HTDK	85.8								
	3	01 003 34	HTDK	84.7								
	4	01 004 34	HTDK	84.2								
	5	01 036 03	OFF									
	6	01 034 04	ON									
	7	03 107 52	RMUM	30.2								
	8	03 108 52	RMUM	30.9								
	9	08 114 39	RMUM	[illegible]								
	10	14 043 12	SMOK									
	11											
	12											

1	2	3	4	5	6	7	8	9	10	11	12
85.2	85.8	84.7	84.2	OFF	ON	30.2	30.9	[illegible]	[illegible]		
85.8	86.9	84.9	84.8	OFF	ON	30.4	29.1	[illegible]	[illegible]		
86.1	87.2	82.1	86.5	OFF	ON	30.5	30.2	[illegible]	[illegible]		
85.4	86.4	82.4	87.7	ON	OFF	31.3	31.0	[illegible]	NORM		
85.0	86.4	83.1	88.4	ON	OFF	32.1	31.4	[illegible]	NORM		

CANCEL

11:22 ALARM SUMMARY LOG

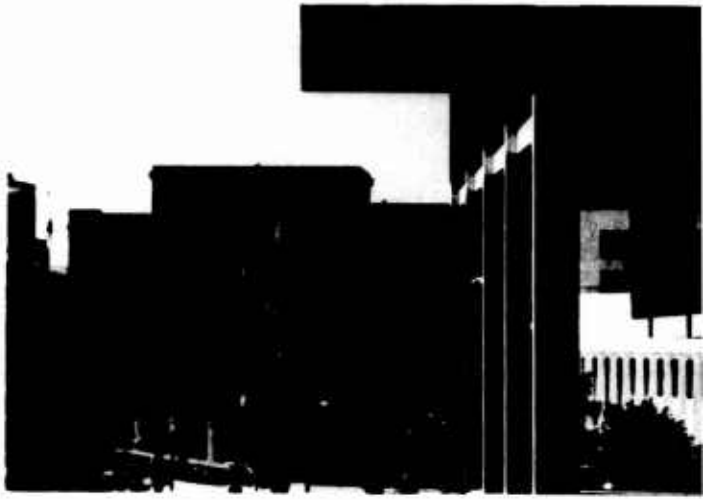
01 002 12	FREE		FREEZESTAT
02 063 09	DIRTY		FILTER
05 078 30	OPEN		PENTHOUSE DOOR4
08 114 39		[illegible]	HITEMP OPERATING MODE
15 081 02	OFF		MAINT REQD 500 HRS

stored memory programs

- Automatic Start/Stop
- Elapsed Equipment Run Time
- Analog Limit Comparison

ECON VI provides these three memory stored programs freeing manpower to perform functions of higher priority. The programs are automatically executed by the central control console utilizing the data stored in the memory modules.

Should it be necessary to change data in any program, the Operator merely addresses ECON VI via the keyboard . . . no codes or elaborate computer programs are required.



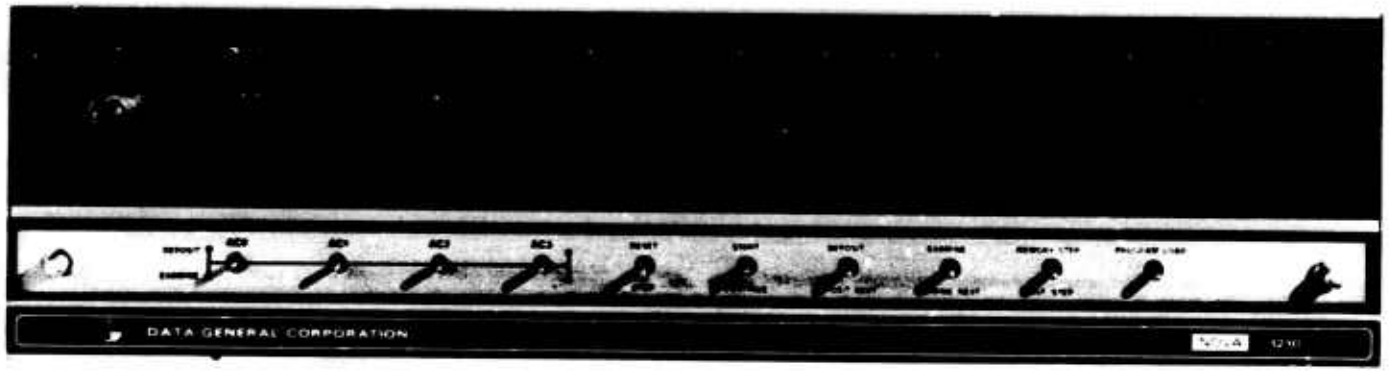
ASR-33 printer

Sends as well as receives data automatically. Prints at 10 characters per second in black. Also includes a keyboard and paper tape reader/punch.

ASR-35 printer

Automatically sends and receives at 10 characters per second. Prints in black with alarms in red. Also includes keyboard for data transmission and paper tape reader/punch.

mini-computer/maxi-performance



The most advanced data processing capabilities of a mini-computer enhance modern building management techniques. Adding the mini-computer module to ECON VI extends the capability of Building Systems Management.

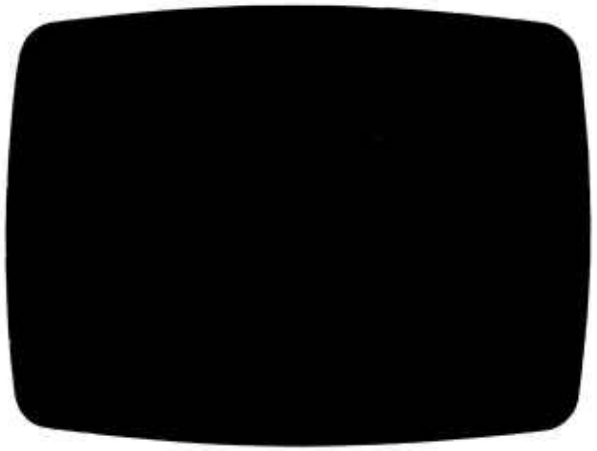
Software programs are available for virtually any application — psychrometric calculations, systems optimization, equipment efficiency routines, electrical utility profiles, closed loop control, historical data analysis, maintenance scheduling, etc.

significant mini-computer features:

- 16 bit word length
- 32,000 word memory capacity
- 1.2 microsecond memory cycle time
- Power failure automatic restart
- Automatic program load
- Real time clock

CRT display

Complete descriptive data is displayed and updated instantaneously on the CRT for the Building Operator's evaluation. All system data and entry from the console keyboard are displayed in full English language formats.

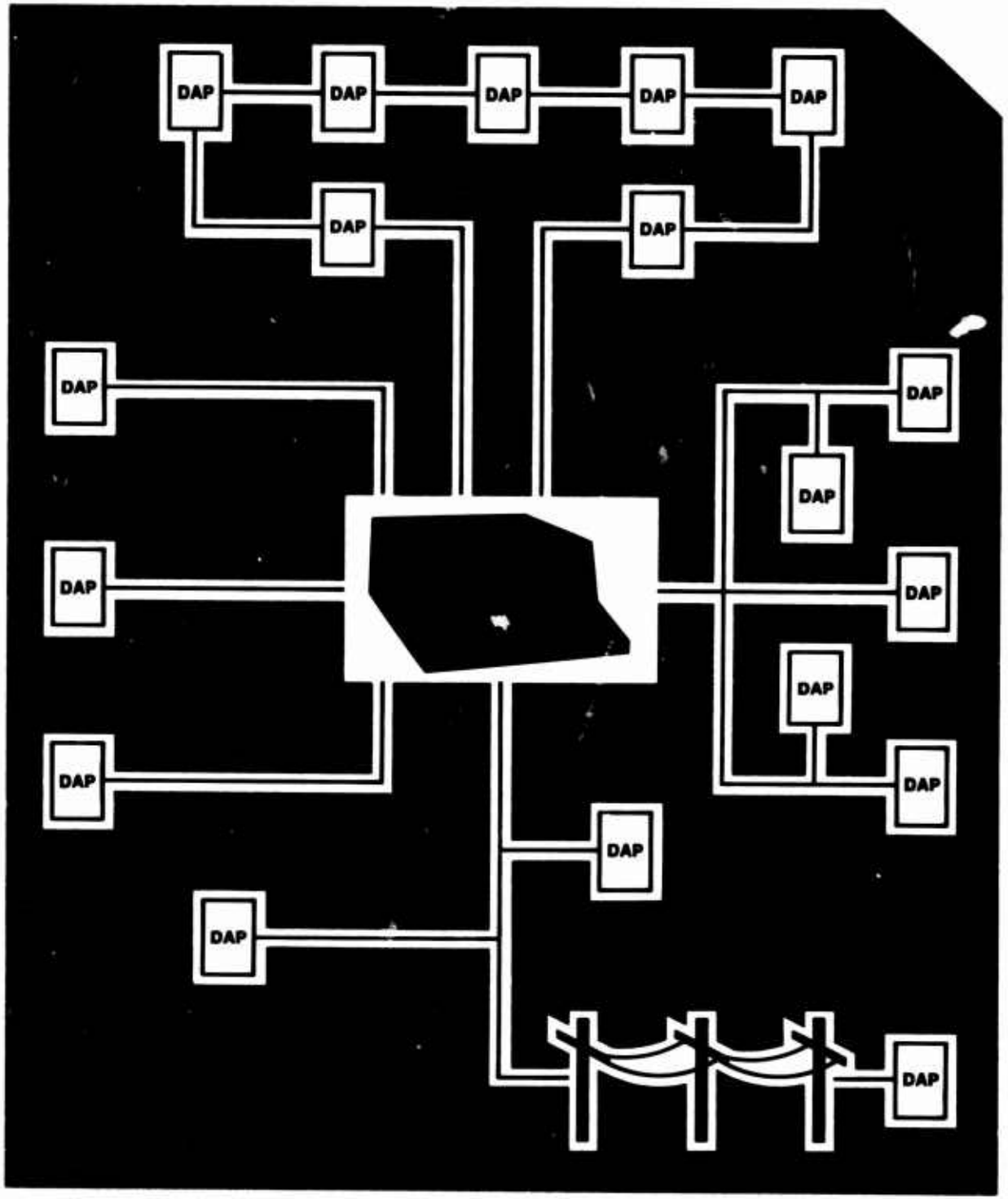


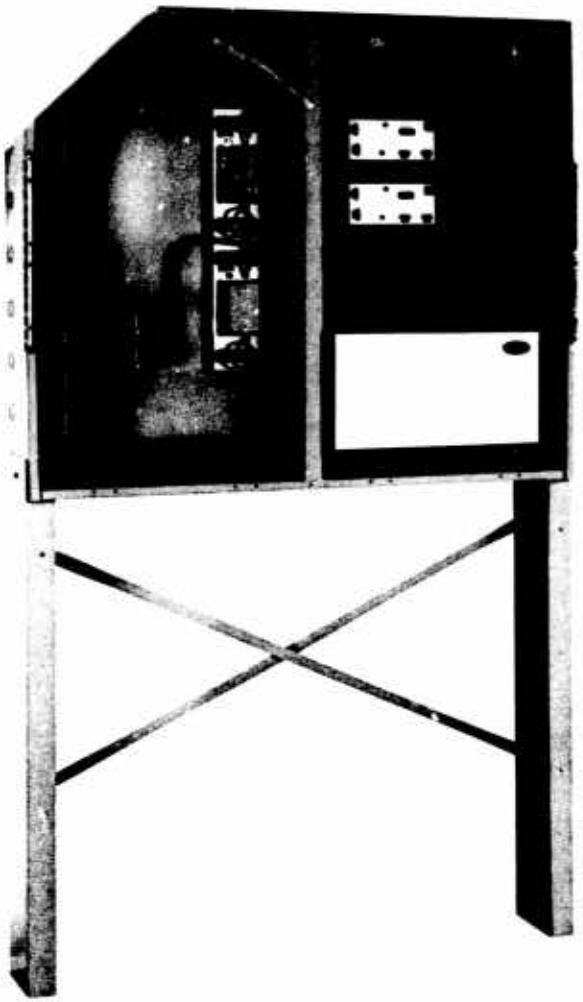
data and system communication

two-wire digital transmission

ECON VI is a true digital communication system employing the most advanced technology available today. Instantaneous data transmission between remote systems and the central control console is a reality.

ECON VI speaks in 16 bit binary words which travel on a twisted pair shielded cable throughout the entire building. Large multi-wire and coaxial cables are not required for ECON VI. Installation and point terminations are greatly simplified since no special tools or terminals are required.





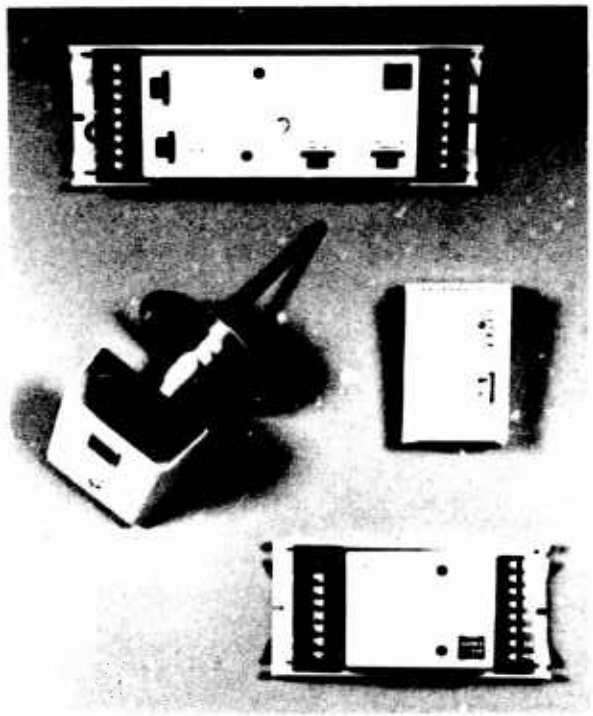
plug-in DAPs

Panels called DAPs are installed at numerous mechanical equipment locations in your building. DAP stands for Data Acquisition Panel. Utilizing T^2L and CMOS electronics, the latest state of the art, the DAPs are the communication links between the central control console and your building mechanical equipment. Each DAP monitors at least one system, and has the capability to handle digital points, analog points, start-stop functions, setpoint adjust functions, as well as provisions for an intercom. All DAPs feature plug-in modules, reducing installation and service time.

Analog data from remote monitoring equipment is converted to digital words by an Analog/Digital Converter at each DAP. These digital words are sent to the ECON VI central console where they are processed, converted to the English language (not computer language) and displayed.

checking your building's "pulse"

Monitoring all phases of your building is a full time job. The numerous building equipment locations utilizing smoke detectors, fire detectors, temperature sensing elements, freeze thermostats, motor start/stop relays, perimeter intrusion detectors, and on and on, can be checked 24 hours a day, everyday. The ECON VI system of equipment monitoring, DAPs and central control console continuously "check the pulse" of your building. Building management information from every location, however remote, is communicated to the operator at the central control console. Problem areas are immediately detected and reported before they become emergencies.



exclusive features of ECON VI:

- Flexible Point Assignment — Point numbering can be assigned in any sequence. Unused systems, channels and points can be left for future expansion
- Failsoft — All remote setpoints assume a preset position if a power failure occurs, preventing complete system shutdown. ECON VI employs non-destructive memory so startup after a power failure is automatic
- Remote A/D Converters — System failure is virtually eliminated since each DAP is independent, having its own Analog/Digital Converter
- Absolute Value Setpoint Control — ECON VI has actual system condition readouts and transmission so there is no guessing about values. To adjust a condition, the operator merely "types in" the actual values at which he wants the system to function (e.g., 68°, not −5+10°)
- Battery Power Backup — In the event of a power failure, an optional standby battery powerpack can maintain an ECON VI system until normal power can be restored
- Parallel Connection — All DAPs are connected in parallel. If one fails, the others continue functioning normally.

human life sa… and security

telephone leased line system

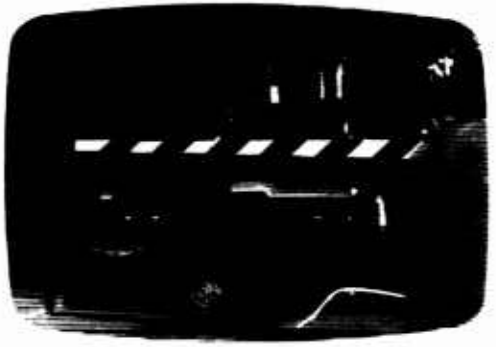
Barber-Colman's ECON VI has virtually unlimited capacity to receive, analyze, and send data to manage entire building complexes. Data transmission from separate buildings is accomplished through dedicated leased telephone lines over long distances. This communication network enables your operator or ours to manage your entire building or complex of buildings from a centrally located ECON VI console.

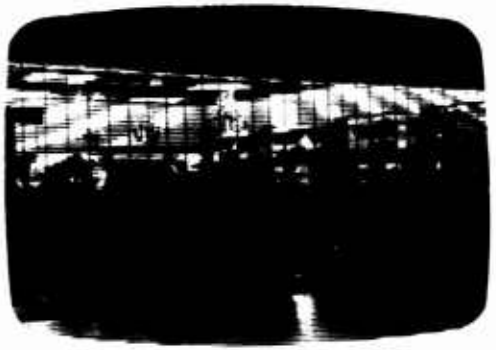
...m system

...speed communication is vital when hu...n life is at stake. ECON VI, utilizing rapid ...ransmission techniques, monitors your entire building's fire detection and alarm network continuously. Employing flame and smoke detectors, thermal fire detectors, firestats, and sprinkler alarms, ECON VI reports and alerts your personnel to any abnormal condition immediately. It pinpoints the location of the problem. In addition, programmed procedures can be automatically activated. Barber-Colman is concerned about human life safety and ECON VI is our answer to preventing loss of lives in your building or complex.

security enforcement systems

Your security force can be multiplied many times (and therefore be much more effective) by using an ECON VI Building Systems Manager. Closed circuit televisions aid in building surveillance. Even greater effectiveness can be realized by employing infrared and microwave intrusion detectors, perimeter protection devices, door and entry detection, ID card readers, parking lot capacity control and so forth. Any or all of these security enforcement techniques and equipment can be linked to ECON VI for rapid 24-hour a day intelligence communications and enhancement of your building's security system.





building systems management approach

When you buy an ECON VI, you buy more than Building Systems Management. You receive the capability and backup of the entire Barber-Colman organization—Engineering, Sales, Service and Maintenance. Because we aren't the giant in the industry, we serve our customers in a personalized way.

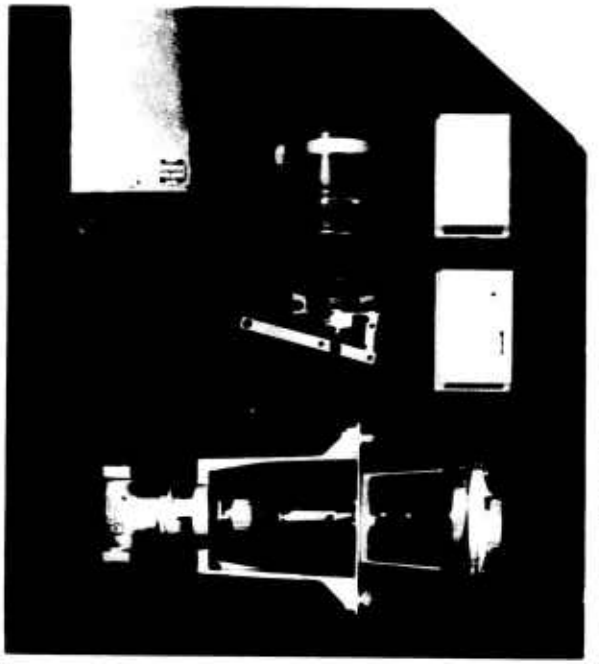
Our Installation and Planned Maintenance Field Specialists take the worry away from the building owner, operator, design engineer and architect. We will install your complete system and insure that it functions efficiently through individualized attention unequalled in the industry.

Barber-Colman has established itself as a leader and innovator in Solid State Controls and Air Distribution Systems.

Barber-Colman provides innovative systems with a complete line of equipment — pneumatic, electric, solid state controls and engineered air distribution products.

We led the industry with our introduction of System 8000 — a complete line of solid state controls that are reliable, versatile and easy to install. We have also pioneered major innovations such as Heat-of-Light, computerized feasibility studies, Variable Air Volume systems, Follow-the-Sun diversity systems, published sound data, comfort charts, and engineered air distribution.

And now, we are presenting ECON VI, a revolutionary new two-wire building automation system that manages your building and pays for itself in operating savings.



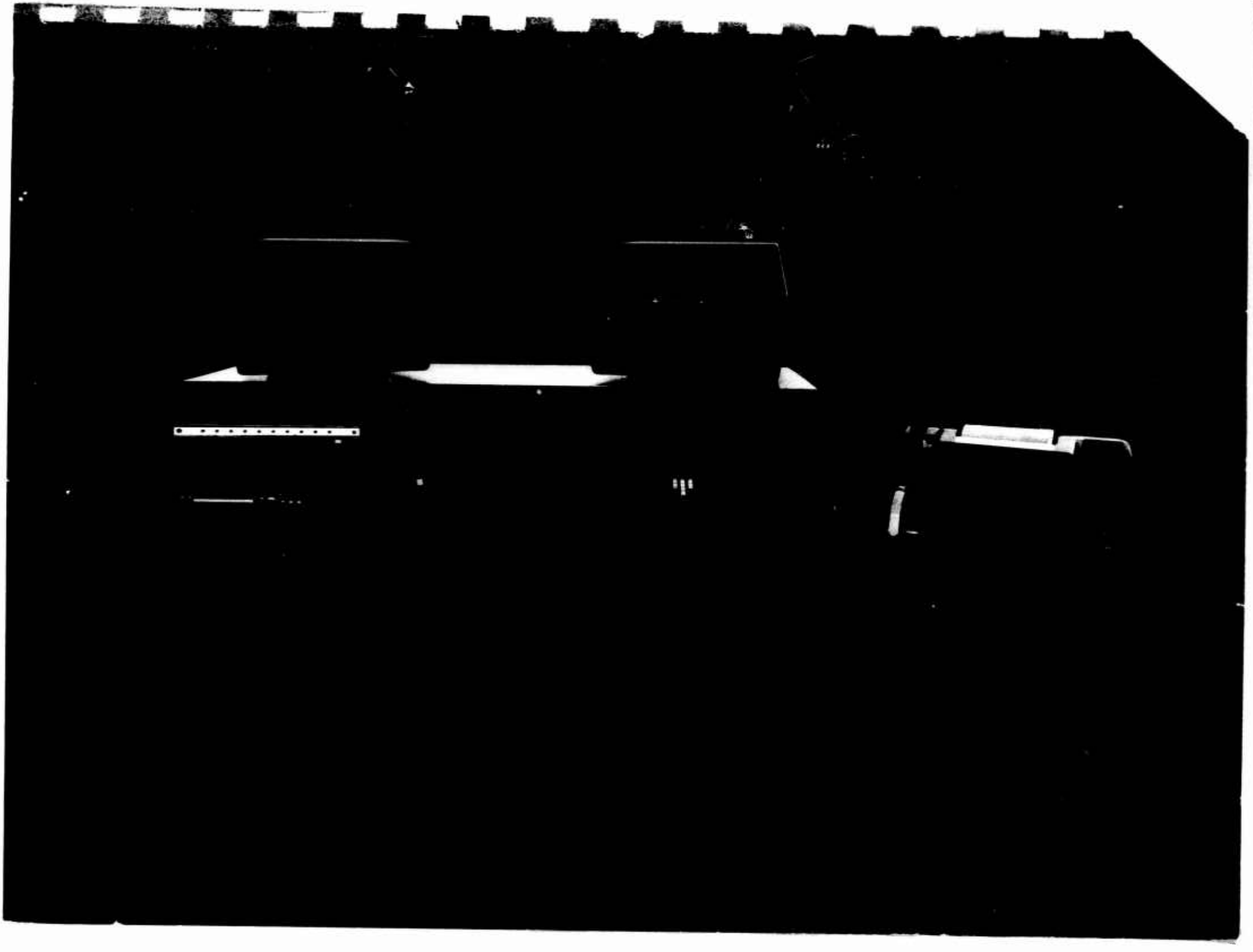
systems engineering

In addition to single source availability, Barber-Colman designs all parts of the system for reliability. Our products are field tested and proven reliable before they are offered to you. When a product is engineered, the total system is considered . . . not only for compatibility, but for total system performance and building equipment optimization. This means you get the finest Building Systems Management and operating cost savings.

people dedicated to serve

Our commitment to provide products and systems for a better environment exists in our entire field organization as well. They too are dedicated to unexcelled quality and workmanship in systems engineering, installation, and maintenance to our customers.

Our entire organization is committed to giving our customers the best service and the finest product line available today.



Barber-Colman Company field organization

Our entire field organization is ready to serve you. Call the office nearest you.

FIELD OFFICE	PHONE
ALABAMA	
Birmingham	205-328-4107
ALASKA	
Anchorage	907-277-7924
ARIZONA	
Phoenix	602-278-6236
ARKANSAS	
Little Rock	501-375-1181
CALIFORNIA	
Bakersfield	805-323-9531
Fresno	209-486-3300
Los Angeles	213-268-2611
Los Angeles	213-268-1801
Sacramento	916-443-3971
San Diego	714-277-8610
San Francisco	415-589-8313
Sherman Oaks	213-784-9707
COLORADO	
Denver	303-777-6633
CONNECTICUT	
New Haven	203-777-3424
FLORIDA	
Tampa	813-689-8866
Jacksonville	904-721-3711
Miami	305-444-6253
GEORGIA	
Atlanta	404-633-2561
HAWAII	
Honolulu	808-841-7333
ILLINOIS	
Chicago	312-274-9705
Niles	312-647-0506
Rock Island	309-786-3351
Rockford Hdqts.	815-877-0241
Rockford	815-633-9585
Springfield, IL	217-528-0406
INDIANA	
Ft. Wayne	219-484-9502
Indianapolis	317-297-4242
So. Bend	219-232 6908
IOWA	
Coralville	319-338-1773
KANSAS	
Kansas City, KS	913-492-9600
Wichita	316-263-7191

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KENTUCKY	
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Louisville	502-491-3557
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Shreveport	318-423-4235
MAINE	
So. Freeport	207-865-4021
MARYLAND	
Baltimore	301-889-2070
Wheaton	301-933-1100
MASSACHUSETTS	
Boston	617-828-6770
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Detroit	313-358-5715
Saginaw	517-777-1005
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Duluth	218-727-1767
Minneapolis	612-374-5690
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Jackson	601-362-0529
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Butte	406-723-8075
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Berlin	609-767-4880
Springfield	201-376-9440
NEW MEXICO	
Albuquerque (Lucas)	505-345-3541
NEW YORK	
Albany (Schenectady)	518-346-1237
Buffalo	716-873-9600
Bronx (New York City)	212-884-6000
NYC	516-694-3434
Rochester	716-275-0990
Syracuse	315-471-8181
NORTH CAROLINA	
Charlotte	704-372-4642
Greensboro	919-273-9465
Raleigh	919-787-6581
OHIO	
Cincinnati	513-271-2500
Cleveland	216-391-7263
Columbus	614-228-4571
North Canton	216-499-8174
Toledo	419-476-6661

FIELD OFFICE	PHONE
OKLAHOMA	
Oklahoma City	405-528-3237
Tulsa	918-663-4946
OREGON	
Portland	503-234-9254
PENNSYLVANIA	
Harrisburg	717-761-2000
Philadelphia	215-455-4000
Pittsburgh	412-884-0200
Willow Grove	215-657-3125
SO. CAROLINA	
Columbia	803-779-4825
Greenville	803-233-4103
TENNESSEE	
Chattanooga	615-698-4016
Knoxville	615-982-1070
Knoxville	615-525-2285
Memphis	901-272-3086
Nashville	615-244-1339
TEXAS	
Dallas	214-352-9741
Houston	713-781-0041
Lubbock	806-747-2927
San Antonio	512-344-6349
UTAH	
Salt Lake City	801-486-0165
VIRGINIA	
Norfolk	804-857-6061
Richmond	804-355-0651
Richmond	804-264-2539
WASHINGTON, D.C.	301-933-1100
WASHINGTON	
Seattle	206-623-2886
Spokane	509-325-1541
WEST VIRGINIA	
Huntington	304-736-8951
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Edmonton	403-453-1417
Halifax	902-429-0902
Hamilton	416-561-9731
London	519-432-7501
Montreal	514-631-9064
No. Vancouver	604-985-7313
Ottowa	613-234-7356
Toronto	416-742-6210

F-15598

Barber-Colman Company ...diversity of quality products

AIR DISTRIBUTION PRODUCTS—Ceiling and sidewall diffusers, variable volume and heat reclaim systems, high and low velocity air distribution products and accessories for the Heating, Ventilating and Air Conditioning Industry.

CONTROLS—Pneumatic, Electric and Solid State temperature, pressure and humidity controls and building automation systems for commercial and industrial buildings and the OEM and over-the-counter markets.

CUTTING TOOLS—Gear generating tools (holes and shaper cutters), form relieved and profile ground milling cutters and reamers for the machine tool industry.

ENVIRONMENTAL SYSTEMS—Complete heating, ventilating and air conditioning systems for commercial, industrial and institutional buildings.

INDUSTRIAL INSTRUMENTS—Indicating and controlling pyrometers, potentiometric recording controllers, thermocouples, combustion safeguards and electronic control instrumentation for manufacturing processes.

MACHINE TOOLS—Hobbing, gear shaping and sharpening machines.

MEDICAL PRODUCTS—Medical diagnostic equipment.

MOLDED PRODUCTS—Thermoset compression and transfer molding products.

MOTORS—Subfractional horsepower shaded-pole motors, commercial d-c motors, gearheads, ultrasensitive d-c relays, and portable harness testors.

PRECISION DYNAMICS—Power controls for marine and industrial diesel, steam and gas turbine engines. Engine control systems for marine vessels. Electromechanical actuators, air valves and control systems for aircraft.

RESOURCE RECOVERY SYSTEMS—Puretec system for solid waste management incorporating the WETOX subsystem.

TEXTILE MACHINERY—Yarn preparation and warp replacement machinery for woven goods. Yarn preparation and Raschel knitters for knitted goods. Special machinery for the textile and related industries.

ECON VI

energy conserving building management

225<

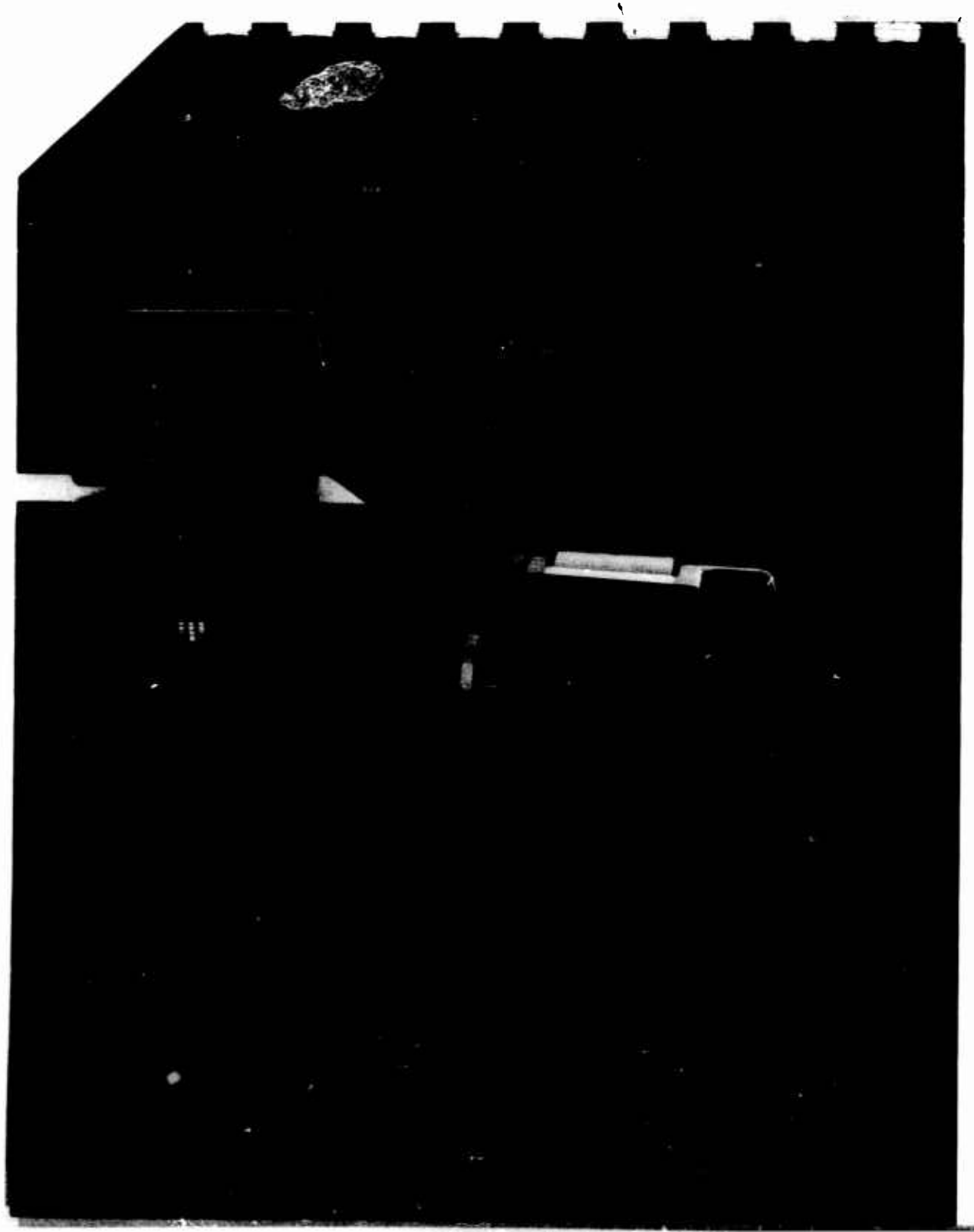
energy conserving building management

ECON VI

the untiring building manager...

Operating 24 hours a day to conserve energy by managing:

• Heating/cooling systems • Energy & power • Human life safety • Building security • People Comfort



...that more than pays its own way

Your building, operating at peak efficiency — as it was designed to operate — is a realistic way to experience real savings in building management. ECON VI, the untiring building manager, pays for itself 24 hours a day by cutting costs, improving manpower utilization and extending equipment life.

You are guaranteed a return on your investment. with dividends you can see every day. ECON VI is a total Building Systems Manager with a real payback.

total building systems management

unlimited systems capability

ECON VI has virtually unlimited capability to gather, process and control building systems data. It will manage all facets of your building, large or small, new or existing. Controlling building comfort, area lighting, entry protection, life safety, energy costs, routine maintenance and preventive maintenance, as well as a host of other functions are "naturals" for ECON VI. It manages an entire building or complex of buildings as one total system. Growth capability to satisfy your requirements for tomorrow's expansion has been designed into ECON VI.

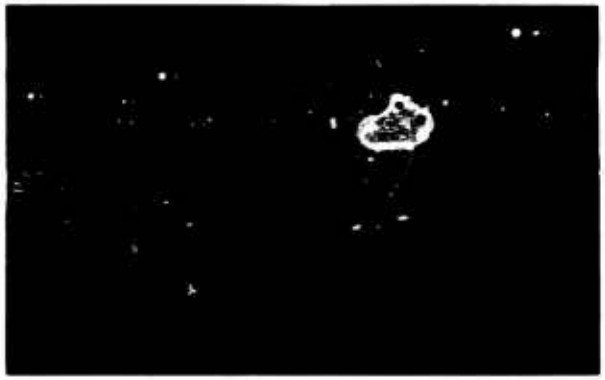
This entirely new concept of Building Systems Management effectively incorporates the latest state of the art electronics and two wire data transmission.

greater operating efficiency . . .
. . . lower operating costs

ECON VI can provide greater comfort, conserve energy, lower building operating costs, minimize system component breakdowns, optimize system efficiency, provide surveillance and security force backup, program routine maintenance, provide fire detection and alarm, and alert personnel to perform preventive maintenance. The result is a finely tuned building system with an added plus — greater operating efficiency and lower operating costs.

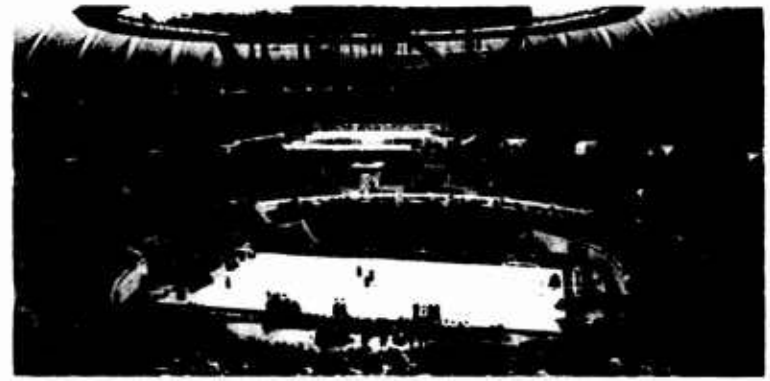
comfort assurance

Occupant comfort is the foremost consideration of any building owner, operator, or designer, as it must be. You can be confident that ECON VI will keep your occupants comfortable and, in addition, provide you with operating cost savings.



energy conservation

The need for energy conservation through building system optimization is a reality today. No longer can building systems be operated at any cost or with excessive equipment; equipment operating efficiency must be maximized. ECON VI conserves energy and lowers your operating budget.



the building manager that more than pays its own way

save energy and manpower

A building of any size operating efficiently and saving money is within your grasp. Consider ECON VI, a centralized control system that manages your entire building while saving money. In fact, ECON VI will pay for itself in a few short years. Start saving through more efficient use of energy and manpower.

ECON VI is an investment with a real payback. When you buy an ECON VI, you buy the capability of the entire Barber-Colman organization. Our personnel give you the personal attention unequaled anywhere else.

programmed efficiency

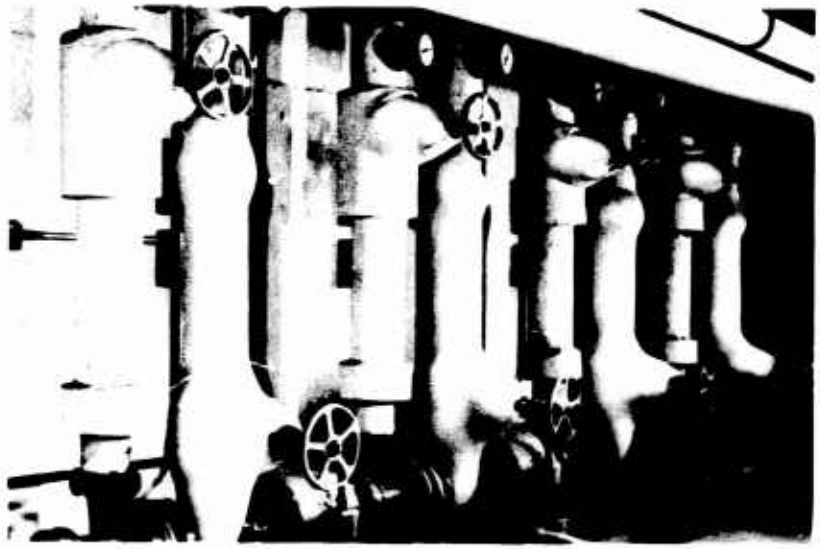
Time consuming functions, such as routine startup and shutdown, monitoring temperatures, pressures, turning lights on and off, as well as a multitude of other tasks can be accomplished automatically by ECON VI. Your maintenance crew need not physically tour the entire building checking individual areas, floors and mechanical equipment. Costly emergency service is drastically reduced through programmed preventive maintenance.

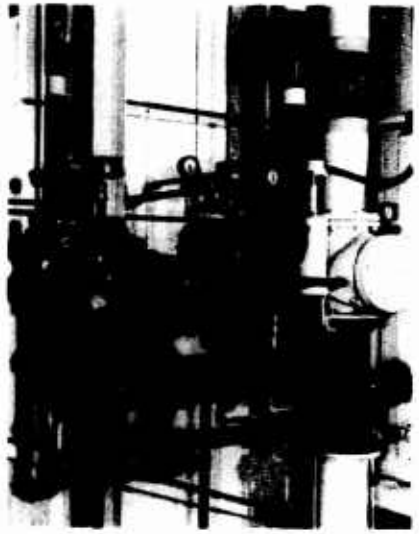
round-the-clock optimization

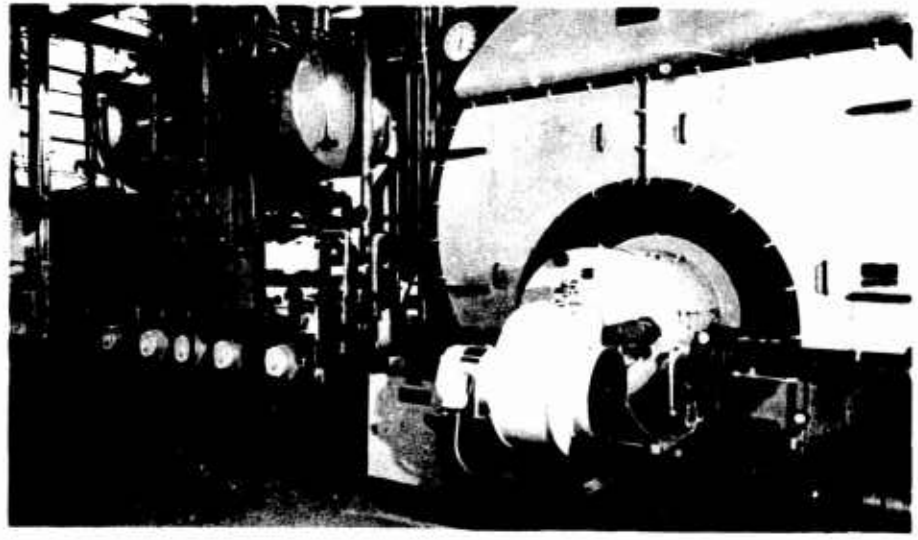
Through 24-hour building management, ECON VI offers real savings through optimum system performance. Typically, a 10 to 30% cost reduction can be realized annually in maintenance, operation, emergency service, fuel and electrical billings.

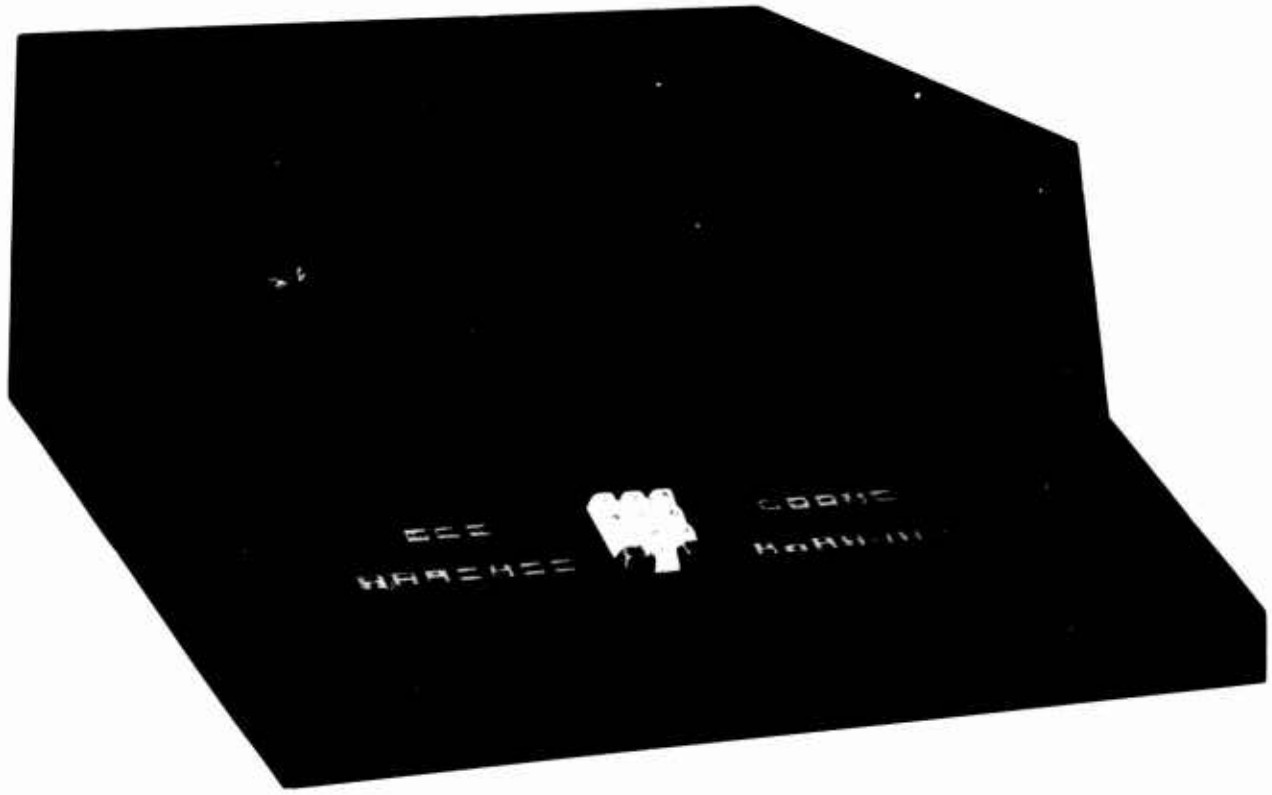
experience real savings with ECON VI:

- Minimize emergency calls through central system monitoring
- Instant reports of equipment malfunctions and abnormal conditions.
- Minimize time spent walking, observing, and recording by using the central console
- Improve operating efficiency through central recording and evaluation of records to construct trends
- Prolong equipment life with preventive maintenance scheduling
- Obtain instant spot checks on temperatures and equipment modes of operation from central control console
- Optimize cooling and reheating through monitoring outside air temp and adjusting dampers
- Reducing electrical demand
- Reduce maintenance manhours with informative equipment displays and audio communications
- Reduce readjustment and switching with central control
- Control lights in unoccupied areas with surveillance at central console
- Instant pinpointing of failures from one location
- Reduce manpower hours with automatic start/stop programs
- Decrease insurance programs by monitoring fire and security systems
- Minimize maintenance time through routine equipment service scheduling.









modular flexibility

ECON VI was designed with a broad spectrum of buildings in mind. Through the use of standard modules, ECON VI can be tailored to your building management objectives. You don't have to buy a sophisticated automation system with equipment you don't require. As system complexity increases, ECON VI can grow with you, while maintaining simplicity of operation.

heart of the system

The heart of the ECON VI Building Management System is the Basic Operator's Console. It is the nerve center that organizes your entire building to save you time and money. It is small enough to fit on a building operating engineer's desk. Yet, as small as it is, it provides:

- Contact Alarm Annunciation
- Analog Indication
- Digital Setpoint Control
- Automatic Equipment Monitoring
- Two-wire Data Transmission
- Visual System and Point Monitoring
- Less Than 1 Second Response Time
- Unlimited Expansion Capability.

operational simplicity

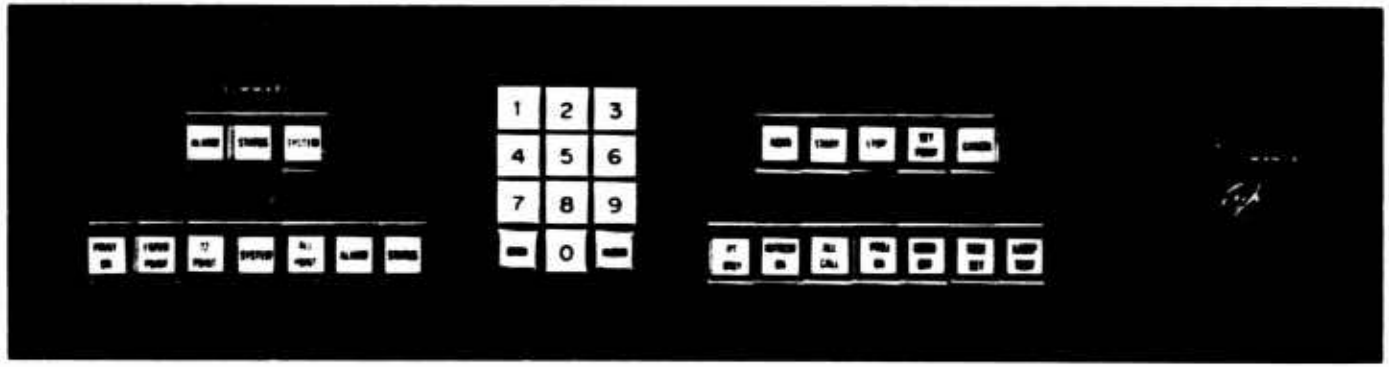
ECON VI, from the Basic Operator's Console to the fully automated system employing a dedicated mini-computer, was designed for simplicity of operation. Since a minimum of technical knowledge is required of the operator, your existing personnel can fully utilize its capability.

visual display

Basic Operator's Console Display. The ECON VI display offers you the opportunity to visually monitor building systems by observing normal and alarm conditions.

system access

Basic Operator's Console Keyboard. The ECON VI keyboard enables you to control building systems — start fans, turn off motors, reset temperatures, and so on — to obtain a comfortable environment and maximize equipment efficiency. Your building Operating Engineer maximizes system performance without leaving the console.



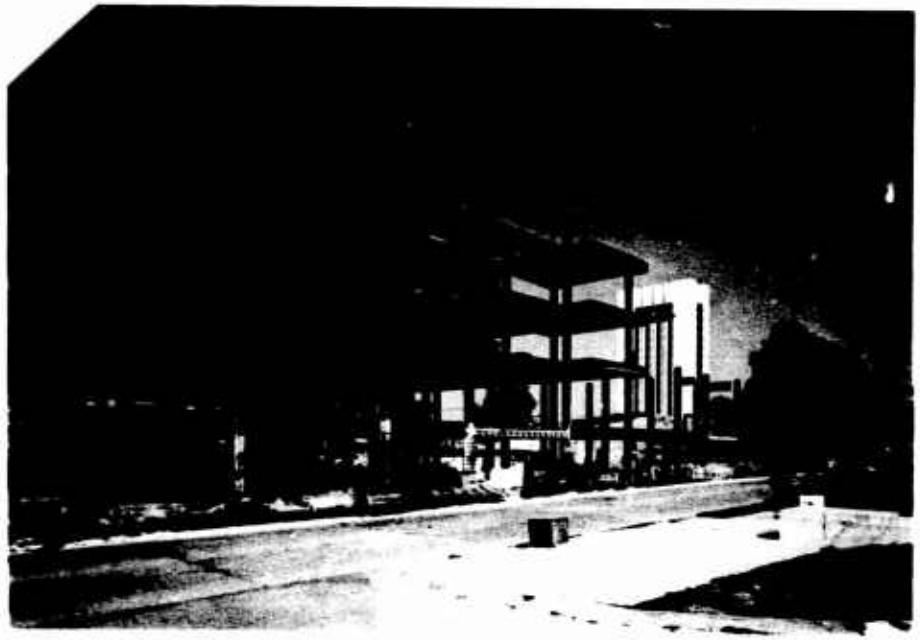
ECON VI grows with you

a planned beginning . . . .

The modular design of ECON VI provides a practical and economical approach to Building Systems Management. Our building management engineers, working with consulting engineers, architects and owners coordinate the parameters of the Building Systems Management functions. Only then is specific equipment selected to manage the building efficiently. The system you select precisely matches the requirements of your specific building. You do not buy auxiliary equipment that remains unused and adds to first costs and operating inefficiency. Yet ECON VI will meet your most sophisticated requirements.

. . . . and modular expansion

When your systems become more complex, ECON VI has the expansion capability to meet that need economically. You don't have to start over by buying a completely new Building Management System . . . you merely add-on to your present automation system, utilizing standard plug-in modules.

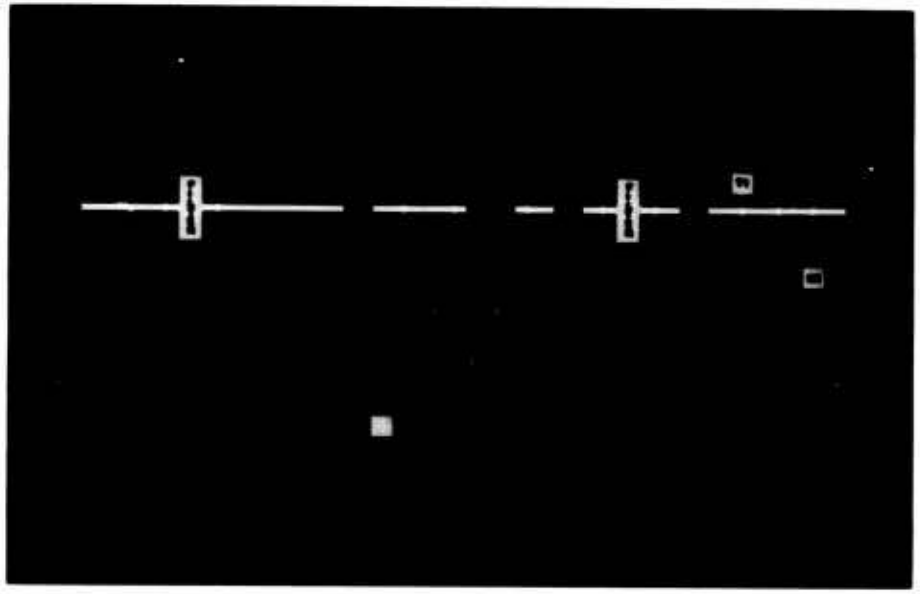


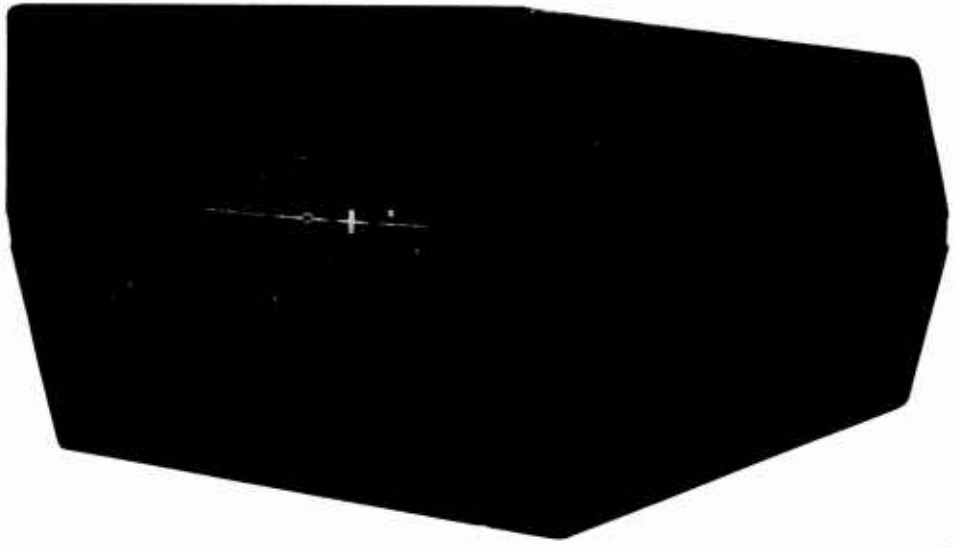
audio communications

Audio monitoring of remote systems and equipment, including multistation tone paging and remote call-in capability.

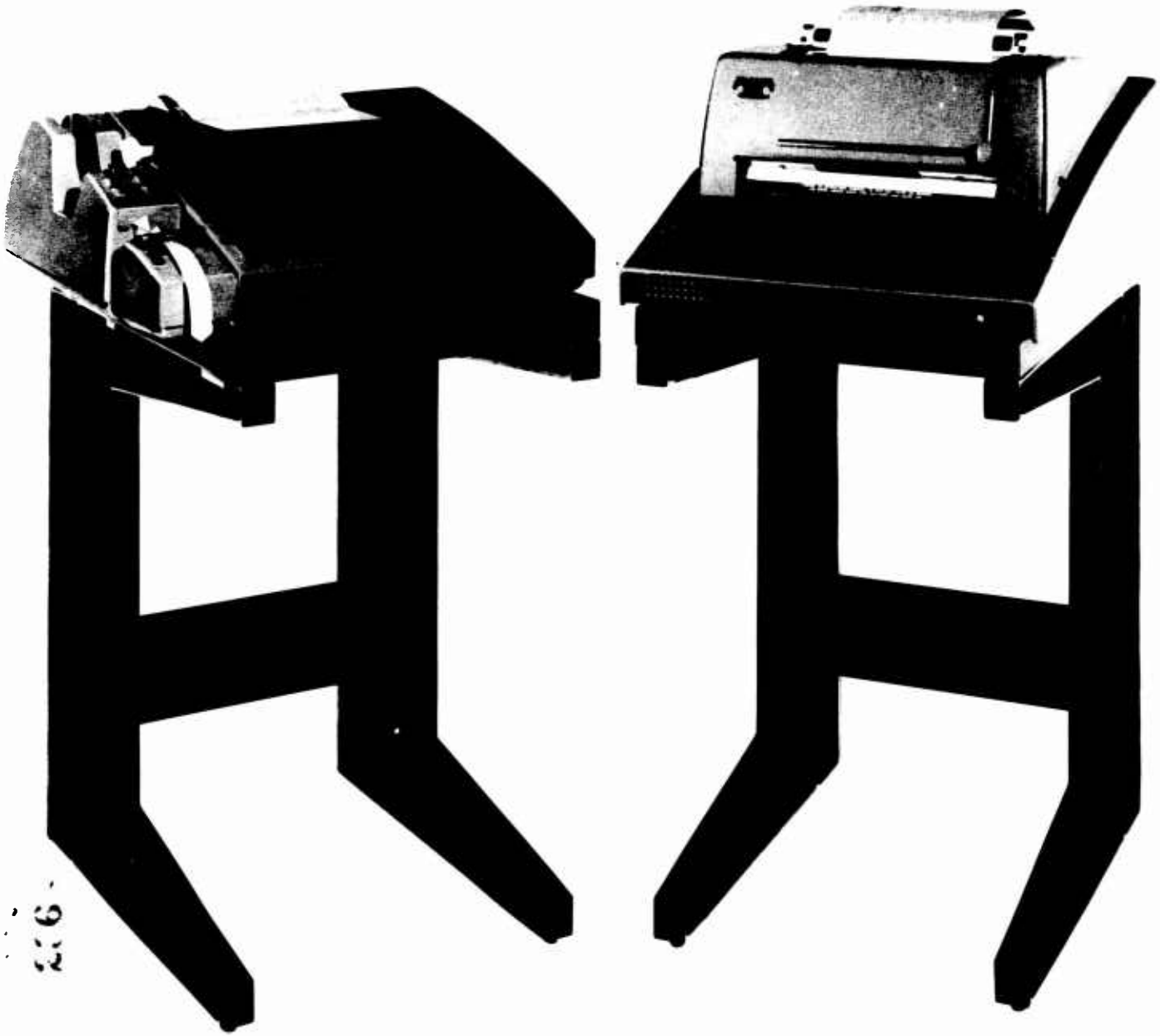
visual display

Provides full-color graphic displays of control building systems configurations, identifying specific systems, points and locations, and has automatic indexing on alarm.





organized expansion without complexity



The level of central automation sophistication is determined by your requirements for Building Systems Management. Sophistication does not necessarily mean complexity. Human engineering was a primary consideration during the design and development phases of ECON VI. ECON VI keeps the operator in mind with designed-in simplicity of operation.

printed system records

Teletype printers provide records of building data for analysis and forecasts. These printers provide clear, concise printouts of alarm summaries, status summaries, system summaries, multiple point trends, system trends and all point logs. Add one or more printers to the central console or to remote locations. Remote printers can provide your personnel with life safety and security information for more effective control.

RO-33 printer

This model receives and prints data. All logs are printed in black at a rate of 10 characters per second.

RO-35 printer

Similar to Model RO-33 with alarm printouts in red.

```
10:14   TREND LOG      INTERVAL:  010 MINUTES

          1   01 001 34  HTDK      85.2
          2   01 002 34  HTDK      85.8
          3   01 003 34  HTDK      84.7
          4   01 004 34  HTDK      84.2
          5   01 036 03   OFF
          6   01 036 04    ON
          7   03 107 52  RHUM      30.2
          8   03 108 52  RHUM      30.9
          9   08 114 39  RHUM      32.6
         10   14 043 12  SMOK
         11
         12

 1    2    3    4    5    6    7    8    9    10   11   12
85.2 85.8 84.7 84.2  OFF   ON 30.2 30.9 32.6  SMOK
85.8 86.9 84.9 84.8  OFF   ON 30.4 29.1 32.8  SMOK
86.1 87.2 82.1 86.5  OFF   ON 30.5 30.2 31.1  SMOK
85.4 86.4 82.4 87.7   ON  OFF 31.3 31.0 31.1  NORM
85.0 86.4 83.1 88.4   ON  OFF 32.1 31.4 31.1  NORM
CANCEL

11:22   ALARM SUMMARY LOG

          01 002 12        FRZE              FREEZESTAT
          02 063 09        DRTY              FILTER
          05 078 30        OPEN              PENTHOUSE DOOR4
          08 114 39                  6...    HITEMP OPERATING ROOM
          1* 081 02         OFF              MAINT REQD  500 HRS
```

stored memory programs

- Automatic Start/Stop
- Elapsed Equipment Run Time
- Analog Limit Comparison

ECON VI provides these three memory stored programs freeing manpower to perform functions of higher priority. The programs are automatically executed by the central control console utilizing the data stored in the memory modules.

Should it be necessary to change data in any program, the Operator merely addresses ECON VI via the keyboard . . . no codes or elaborate computer programs are required.

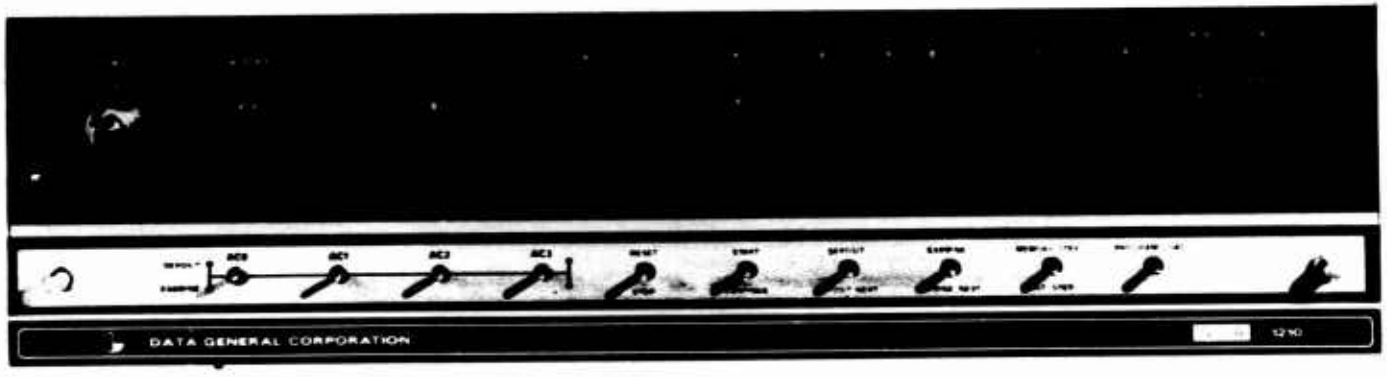
ASR-33 printer

Sends as well as receives data automatically. Prints at 10 characters per second in black. Also includes a keyboard and paper tape reader/punch.

ASR-35 printer

Automatically sends and receives at 10 characters per second. Prints in black with alarms in red. Also includes keyboard for data transmission and paper tape reader/punch.

mini-computer/maxi-performance



The most advanced data processing capabilities of a mini-computer enhance modern building management techniques. Adding the mini-computer module to ECON VI extends the capability of Building Systems Management.

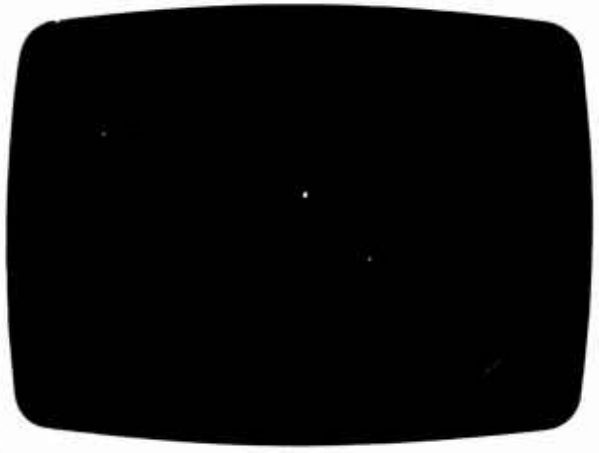
Software programs are available for virtually any application — psychrometric calculations, systems optimization, equipment efficiency routines, electrical utility profiles, closed loop control, historical data analysis, maintenance scheduling, etc.

significant mini-computer features:

- 16 bit word length
- 32,000 word memory capacity
- 1.2 microsecond memory cycle time
- Power failure automatic restart
- Automatic program load
- Real time clock

CRT display

Complete descriptive data is displayed and updated instantaneously on the CRT for the Building Operator's evaluation. All system data and entry from the console keyboard are displayed in full English language formats.

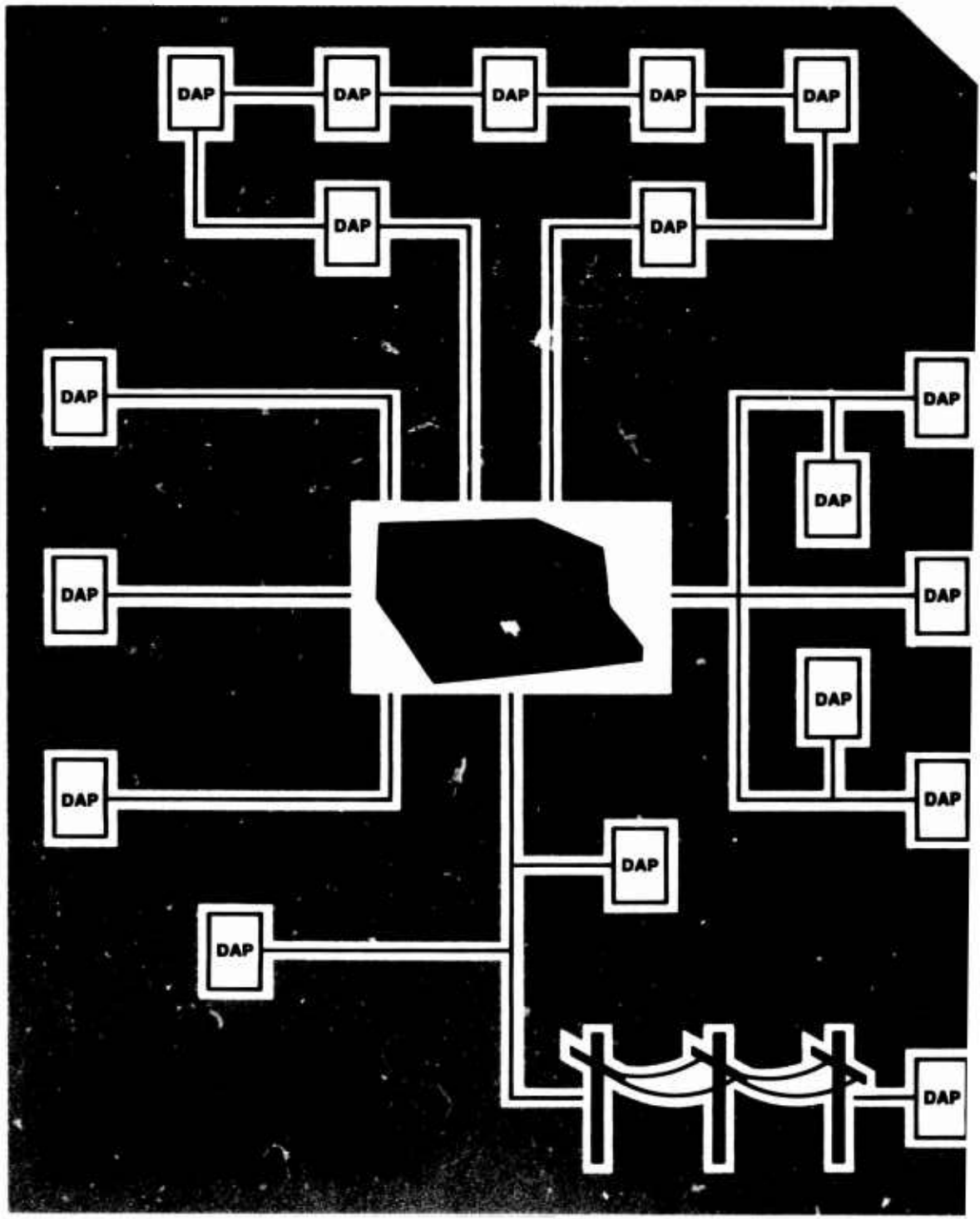


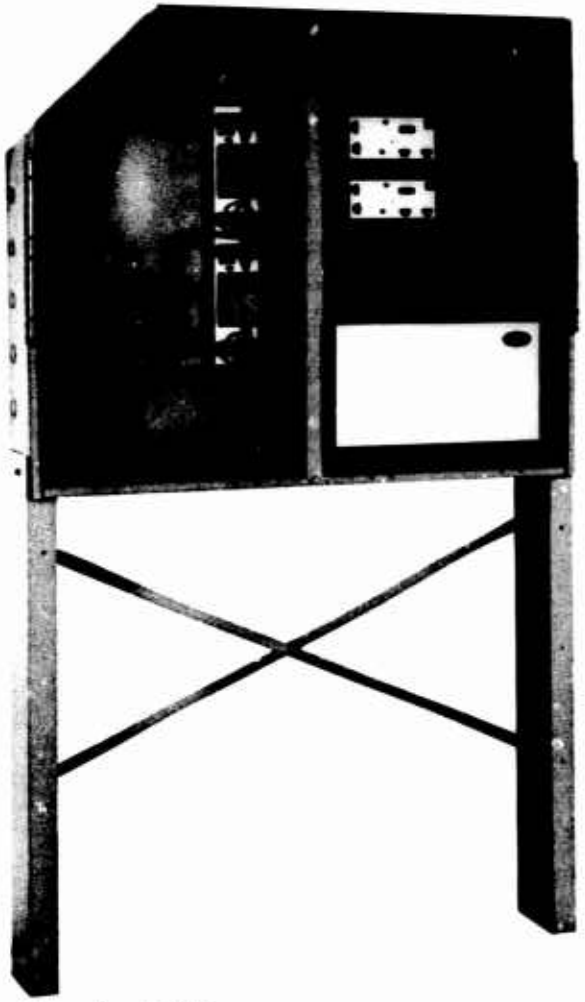
data and system communication

two-wire digital transmission

ECON VI is a true digital communication system employing the most advanced technology available today. Instantaneous data transmission between remote systems and the central control console is a reality.

ECON VI speaks in 16 bit binary words which travel on a twisted pair shielded cable throughout the entire building. Large multi-wire and coaxial cables are not required for ECON VI. Installation and point terminations are greatly simplified since no special tools or terminals are required.





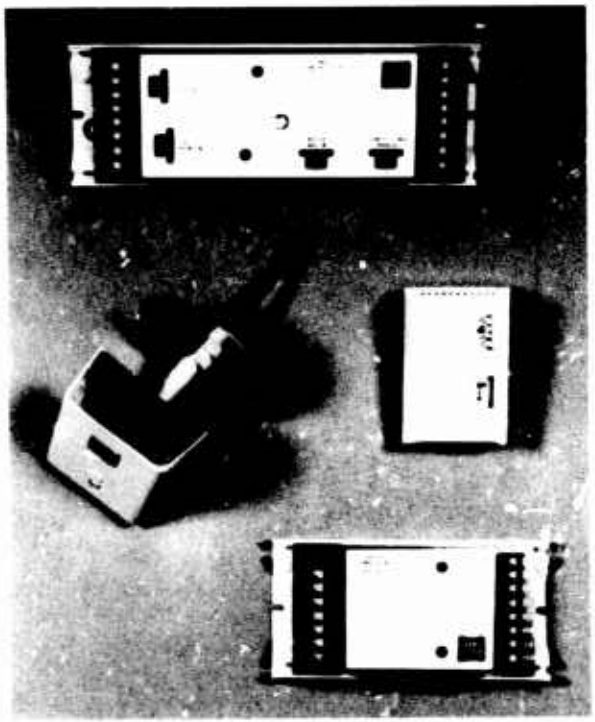
plug-in DAPs

Panels called DAPs are installed at numerous mechanical equipment locations in your building. DAP stands for Data Acquisition Panel. Utilizing T²L and CMOS electronics, the latest state of the art, the DAPs are the communication links between the central control console and your building mechanical equipment. Each DAP monitors at least one system, and has the capability to handle digital points, analog points, start-stop functions, setpoint adjust functions, as well as provisions for an intercom. All DAPs feature plug-in modules, reducing installation and service time.

Analog data from remote monitoring equipment is converted to digital words by an Analog/Digital Converter at each DAP. These digital words are sent to the ECON VI central console where they are processed, converted to the English language (not computer language) and displayed.

checking your building's "pulse"

Monitoring all phases of your building is a full time job. The numerous building equipment locations utilizing smoke detectors, fire detectors, temperature sensing elements, freeze thermostats, motor start/stop relays, perimeter intrusion detectors, and on and on, can be checked 24 hours a day, everyday. The ECON VI system of equipment monitoring, DAPs and central control console continuously "check the pulse" of your building. Building management information from every location, however remote, is communicated to the operator at the central control console. Problem areas are immediately detected and reported before they become emergencies.



exclusive features of ECON VI:

- Flexible Point Assignment — Point numbering can be assigned in any sequence. Unused systems, channels and points can be left for future expansion
- Failsoft — All remote setpoints assume a preset position if a power failure occurs, preventing complete system shutdown. ECON VI employs non-destructive memory so startup after a power failure is automatic
- Remote A/D Converters — System failure is virtually eliminated since each DAP is independent, having its own Analog/Digital Converter
- Absolute Value Setpoint Control — ECON VI has actual system condition readouts and transmission so there is no guessing about values. To adjust a condition, the operator merely "types in" the actual values at which he wants the system to function (e.g., 68°, not −5+10°)
- Battery Power Backup — In the event of a power failure, an optional standby battery powerpack can maintain an ECON VI system until normal power can be restored
- Parallel Connection — All DAPs are connected in parallel. If one fails, the others continue functioning normally.

human life safe and security

telephone leased line system

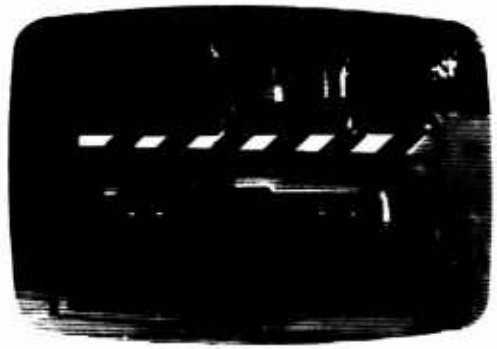
Barber-Colman's ECON VI has virtually unlimited capacity to receive, analyze, and send data to manage entire building complexes. Data transmission from separate buildings is accomplished through dedicated leased telephone lines over long distances. This communication network enables your operator or ours to manage your entire building or complex of buildings from a centrally located ECON VI console.

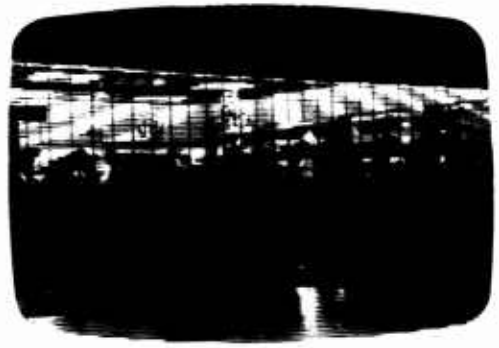
.m system

.speed communication is vital when hu-
.l life is at stake. ECON VI, utilizing rapid
.ransmission techniques, monitors your entire building's fire detection and alarm network continuously. Employing flame and smoke detectors, thermal fire detectors, firestats, and sprinkler alarms, ECON VI reports and alerts your personnel to any abnormal condition immediately. It pinpoints the location of the problem. In addition, programmed procedures can be automatically activated. Barber-Colman is concerned about human life safety and ECON VI is our answer to preventing loss of lives in your building or complex.

security enforcement systems

Your security force can be multiplied many times (and therefore be much more effective) by using an ECON VI Building Systems Manager. Closed circuit televisions aid in building surveillance. Even greater effectiveness can be realized by employing infrared and microwave intrusion detectors, perimeter protection devices, door and entry detection, ID card readers, parking lot capacity control and so forth. Any or all of these security enforcement techniques and equipment can be linked to ECON VI for rapid 24-hour a day intelligence communications and enhancement of your building's security system.





building systems management approach

When you buy an ECON VI, you buy more than Building Systems Management. You receive the capability and backup of the entire Barber-Colman organization—Engineering, Sales, Service and Maintenance. Because we aren't the giant in the industry, we serve our customers in a personalized way.

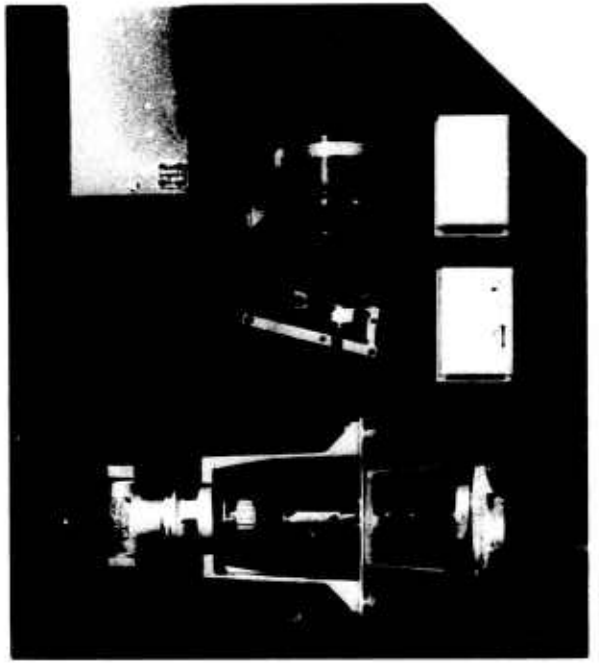
Our Installation and Planned Maintenance Field Specialists take the worry away from the building owner, operator, design engineer and architect. We will install your complete system and insure that it functions efficiently through individualized attention unequalled in the industry.

Barber-Colman has established itself as a leader and innovator in Solid State Controls and Air Distribution Systems.

Barber-Colman provides innovative systems with a complete line of equipment — pneumatic, electric, solid state controls and engineered air distribution products.

We led the industry with our introduction of System 8000 — a complete line of solid state controls that are reliable, versatile and easy to install. We have also pioneered major innovations such as Heat-of-Light, computerized feasibility studies, Variable Air Volume systems, Follow-the-Sun diversity systems, published sound data, comfort charts, and engineered air distribution.

And now, we are presenting ECON VI, a revolutionary new two-wire building automation system that manages your building and pays for itself in operating savings.



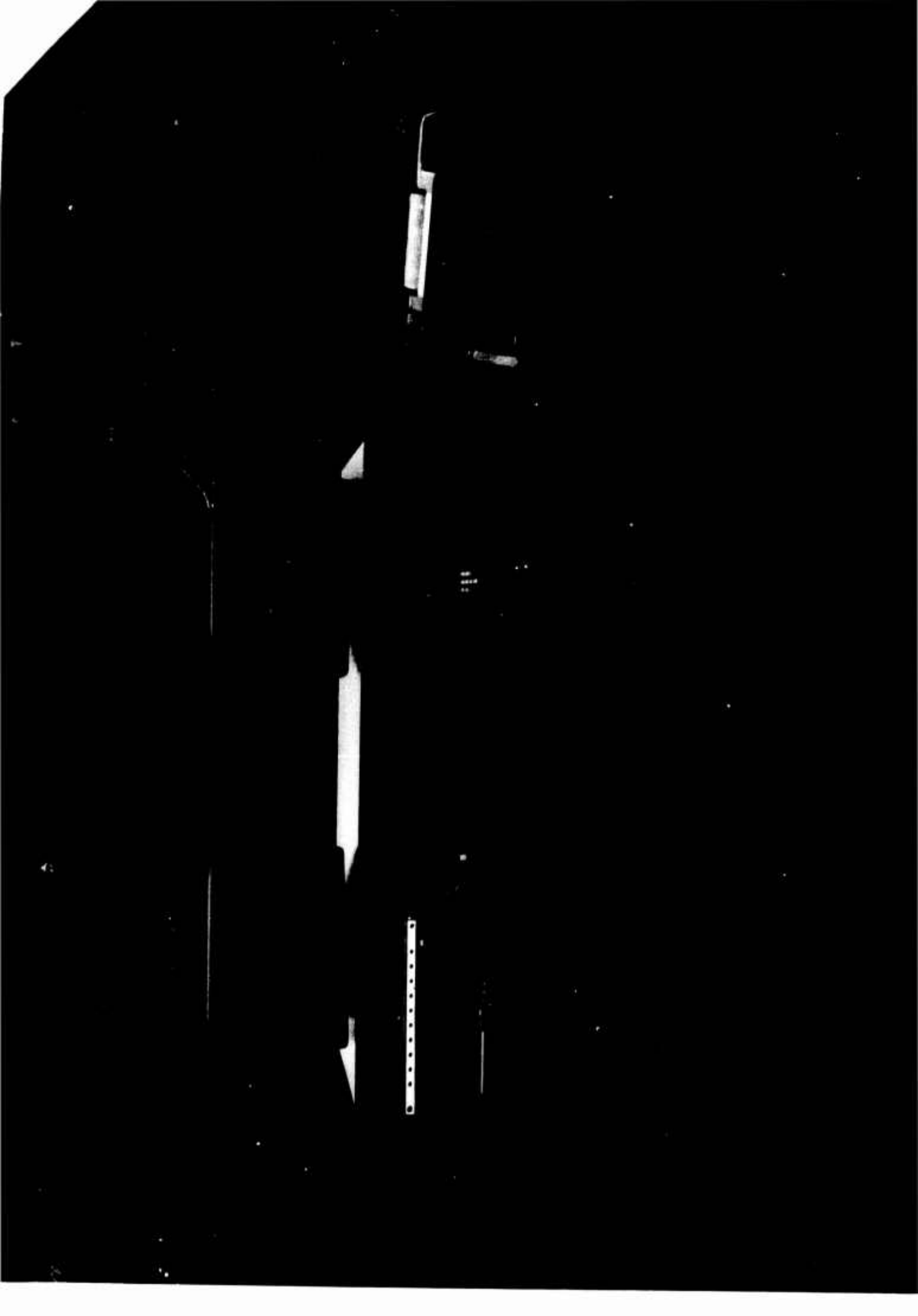
systems engineering

In addition to single source availability, Barber-Colman designs all parts of the system for reliability. Our products are field tested and proven reliable before they are offered to you. When a product is engineered, the total system is considered . . . not only for compatibility, but for total system performance and building equipment optimization. This means you get the finest Building Systems Management and operating cost savings.

people dedicated to serve

Our commitment to provide products and systems for a better environment exists in our entire field organization as well. They too are dedicated to unexcelled quality and workmanship in systems engineering, installation, and maintenance to our customers.

Our entire organization is committed to giving our customers the best service and the finest product line available today.



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ECON VI

energy conserving building management

Barber-Colman Company field organization

Our entire field organization is ready to serve you. Call the office nearest you.

FIELD OFFICE	PHONE
ALABAMA	
Birmingham	205-328-4107
ALASKA	
Anchorage	907-277-7924
ARIZONA	
Phoenix	602-278-6236
ARKANSAS	
Little Rock	501-375-1181
CALIFORNIA	
Bakersfield	805-323-9531
Fresno	209-486-3300
Los Angeles	213-268-2611
Los Angeles	213-268-1801
Sacramento	916-443-3971
San Diego	714-277-8610
San Francisco	415-589-8313
Sherman Oaks	213-784-9707
COLORADO	
Denver	303-777-6633
CONNECTICUT	
New Haven	203-777-3424
FLORIDA	
Tampa	813-689-8866
Jacksonville	904-721-3711
Miami	305-444-6253
GEORGIA	
Atlanta	404-633-2561
HAWAII	
Honolulu	808-841-7333
ILLINOIS	
Chicago	312-274-9705
Niles	312-647-0506
Rock Island	309-786-3351
Rockford Hdqts.	815-877-0241
Rockford	815-633-9585
Springfield, IL	217-528-0406
INDIANA	
Ft. Wayne	219-484-9502
Indianapolis	317-297-4242
So. Bend	219-232-6908
IOWA	
Coralville	319-338-1773
KANSAS	
Kansas City, KS	913-492-9600
Wichita	316-263-7191

FIELD OFFICE	PHONE
KENTUCKY	
Louisville	502-585-4286
Louisville	502-491-3557
LOUISIANA	
New Orleans	504-885-4180
Shreveport	318-423-4235
MAINE	
So. Freeport	207-865-4021
MARYLAND	
Baltimore	301-889-2070
Wheaton	301-933-1100
MASSACHUSETTS	
Boston	617-828-6770
Hartford/Springfield	413-781-5402
MICHIGAN	
Detroit	313-358-5715
Saginaw	517-777-1005
MINNESOTA	
Duluth	218-727-1767
Minneapolis	612-374-5690
MISSISSIPPI	
Jackson	601-362-0529
MISSOURI	
Kansas City, KS	913-492-9600
St. Louis	314-781-9000
MONTANA	
Butte	406-723-8075
NEW JERSEY	
Berlin	609-767-4880
Springfield	201-376-9440
NEW MEXICO	
Albuquerque (Lucas)	505-345-3541
NEW YORK	
Albany (Schenectady)	518-346-1237
Buffalo	716-873-9600
Bronx (New York City)	212-884-6000
NYC	516-694-3434
Rochester	716-275-0990
Syracuse	315-471-8181
NORTH CAROLINA	
Charlotte	704-372-4642
Greensboro	919-273-9465
Raleigh	919-787-6581
OHIO	
Cincinnati	513-271-2500
Cleveland	216-391-7263
Columbus	614-228-4571
North Canton	216-499-8174
Toledo	419-476-6661

FIELD OFFICE	PHONE
OKLAHOMA	
Oklahoma City	405-528-3237
Tulsa	918-663-4946
OREGON	
Portland	503-234-9254
PENNSYLVANIA	
Harrisburg	717-761-2000
Philadelphia	215-455-4000
Pittsburgh	412-884-0200
Willow Grove	215-657-3125
SO. CAROLINA	
Columbia	803-779-4825
Greenville	803-233-4103
TENNESSEE	
Chattanooga	615-698-4016
Knoxville	615-982-1070
Knoxville	615-525-2285
Memphis	901-272-3086
Nashville	615-244-1339
TEXAS	
Dallas	214-352-9741
Houston	713-781-0041
Lubbock	806-747-2927
San Antonio	512-344-6349
UTAH	
Salt Lake City	801-486-0165
VIRGINIA	
Norfolk	804-857-6061
Richmond	804-355-0651
Richmond	804-264-2539
WASHINGTON, D.C.	301-933-1100
WASHINGTON	
Seattle	206-623-2886
Spokane	509-325-1341
WEST VIRGINIA	
Huntington	304-736-8951
WISCONSIN	
Milwaukee	414-464-5900
CANADA	
Calgary	403-243-3421
Edmonton	403-453-1417
Halifax	902-429-0902
Hamilton	416-561-9731
London	519-432-7501
Montreal	514-631-9064
No. Vancouver	604-985-7313
Ottowa	613-234-7356
Toronto	416-742-6210

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